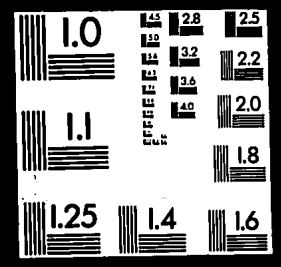

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Thomas A. Edison Papers

A SELECTIVE MICROFILM EDITION
PART V
(1911–1919)

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at
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START

231

A Note on the Sources

The pages which have been filmed are the best copies available. Every technical effort possible has been made to ensure legibility.

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NOTEBOOK SERIES
NOTEBOOKS BY EDISON

Notebook Series -- Notebooks by Edison
Notebook, N-16-01-01

This notebook was used by Edison, probably during the period November 1917-January 1918, to record information taken from naval intelligence reports. Scattered throughout the book are numerous entries with dates ranging from 1915 through 1918, but the dates appear to refer to the date of the event described or the intelligence report consulted, rather than the day on which the information was entered into the notebook. Included are accounts and observations pertaining to wartime shipping and naval operations, along with occasional suggestions for strategic or technological improvements. There are numerous references to submarine warfare and to the equipment of submarines, both German and Allied. Also included are notes on torpedo detection, naval communications, ordinance, storage batteries, and the use of airplanes, zeppelins, and balloons. Specific battles and naval engagements are frequently mentioned. The cover is marked "War" and "4." The pages are unnumbered. Approximately 160 pages have been used.

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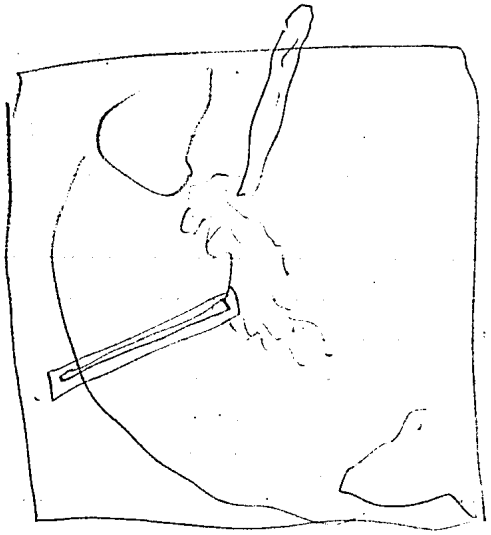
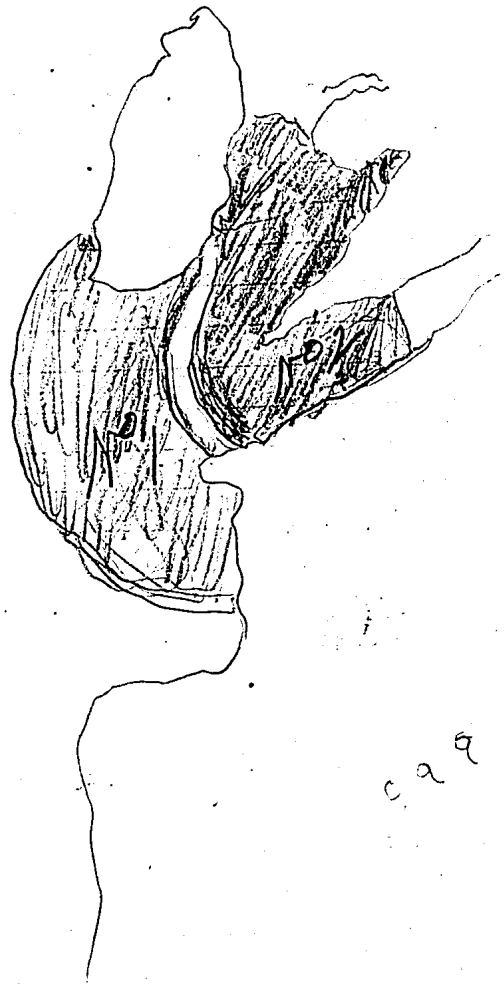
1260 4 50





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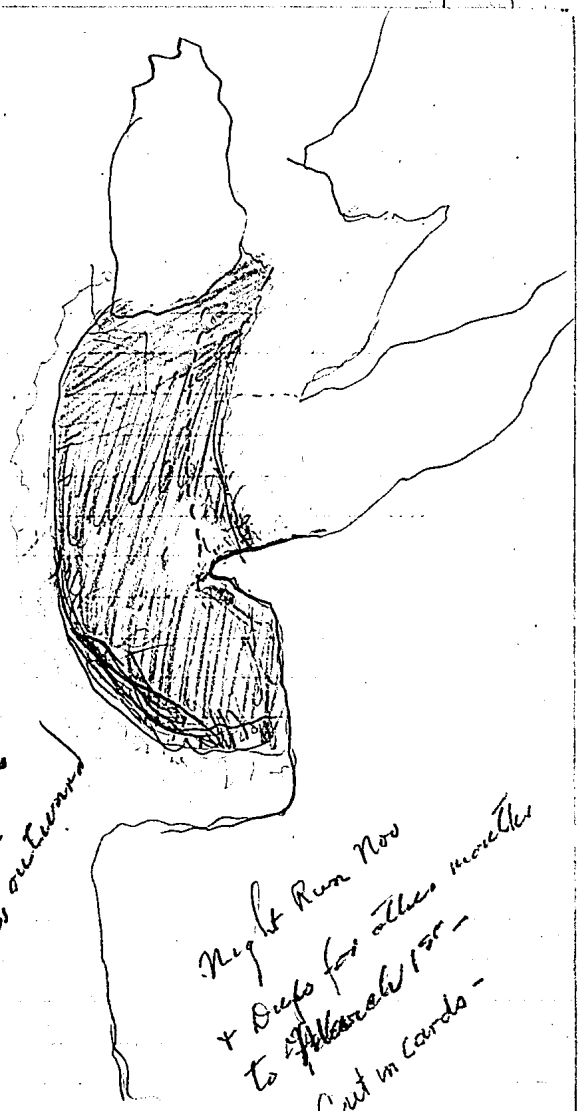
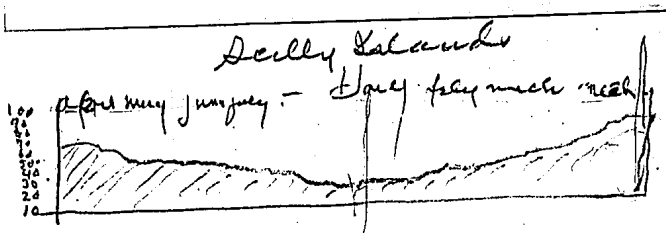


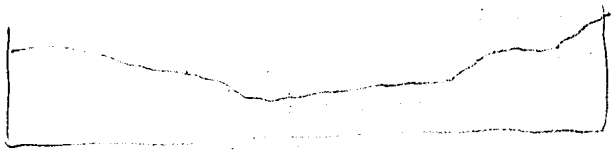
Based on
11 Knots
now –
9 Knots outward

Night Run Now
+ Days for other months
to [illegible] –
Cut in cards –

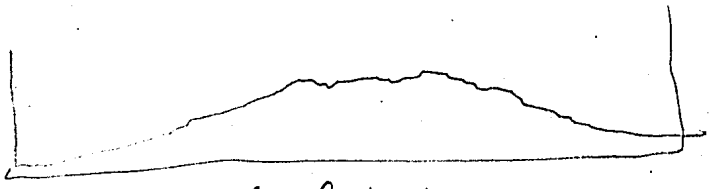
Scilly Islands



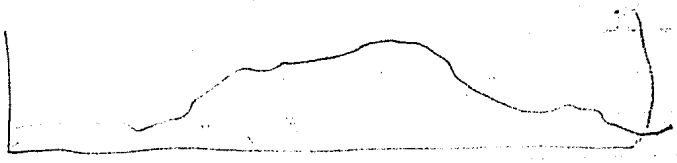
Amount of sunshine days



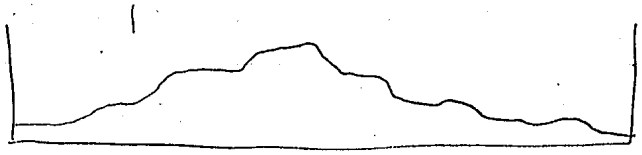
Rainy days.



amount of darkness absolutely



amount of twilight + darkness



If Volume of shipping is the same also the number of submarines the same, The above Curve shows the number of vessels which will be sunk in Nov Dec 1917 + Jan Feby March April May June + July 1918

1260

36

1205 miles

April 21 55
28 48
Mchy 5 46

Mch 56
April 177 Oct 96
Nov 55
May 191
June 148
July 165
Aug 169
Sept 95

Jany	1	7.1		
	2	5.4		
	3	6.4		
	4	21.0		
Feby	1	10.5		
	2	19.6		
	3	20.3		
	4	8.3		
	½	3.8		
March	½	8.3	22	14
	1	8.5	17	13
	2	5.1	24	16
	3	10.7	25	18
	4	24.2	31	18
		56.8		79
April	1	50.	19	17
	2	43.2	28	19
	3	14	55	40
	4	57.6	48	35
		164		111
May	1	19	48	24
	2	13.1	23	18
	3	62.7	27	18
	4	59	19	18
	½	38.2	18	15
		192		93

Sum

56	79
164	111
192	93
56	100
135	52
167	65
95	64

June	1/2	17.3	18	15
	1	44.8	32	22
	2	33.2	32	27
	3	27.4	28	21
	4	30.7	20	15
		156.9		100
July	1	30.4	20	15
	2	21.9	17	14
	3	37.4	18	14
	4	45.3	24	21
			21	18
		135.2		82
Aug		167.1		21
				14
				15
				18
				68
Sept		98—		20
				12
				8
				13
				11
				64

29 — 1
60 — 1
~~50 — 1~~
~~43 — 1~~
47-48 4
38-40 4
33-35-36-37- 8
43-44- 3
50-52-53- 5

~~29 1~~
~~53 11~~
~~60 1~~
~~36 11~~
~~44 1~~
~~20 11~~
~~38 1~~
~~40 1~~
~~48 1~~

50-1
~~35 1~~
43-
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47
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~~47~~
~~40~~
~~37~~

~~47-45 4~~
38-40- 4
33 1
35-36-37. 8
44- 1
43 1
50.52-53 4

Intelligence -

Composition of Mexican dummy to make smoke when TNT sharpnel explodes - (Russian shell) TNT in separate brass cases & then placed in shell -

Italian 18 Sub M to keep at sea
Commander says very difficult to hand on personnel -
Can submerge from surface running in 4 minutes - 30 sec

English (American made) Sub M
Periscope pull down -

Dane subs have collapsible boats lashed to side of conning tower
~~[illegible]~~

Italian Cruiser going 18 knots
2 Torpedoes fired 1 missed
other struck. Capsized in 20
min – just after daylight was
attacked –

German Sub in Adriatic used as
bait to fool Destroyer which tried
ram him after trick scow thrown
Torpedoed in bow Destroyer
sunk – trying ram down sub

English has Merchant Vessels
which appear in Dalhousie to
be War ships

Italian Cruising ships have a
fake bow wave painted to
give submarine idea of going
great speed
English did it & then stopped it

English drag line with Travelers
bombs on line electrically
Exploded – when line caught
that particular part with bomb
Exploded –

~~Ital~~ Cant lay mines in Brindisi
Channel too deep & tide too
strong ? so stated by Spaniard

Chg on tap Diesel Engine to leeward
Could be heard for miles on
Calm night – Destroyer Drifts
along then suddenly throws
arc light on & fires –

French have 65
Converted boats patrolling
Channel Theer 1/– from La Hague
~~Channel~~ they divide area in squares
Each drifts around in their square
speed 9 @ 11 Knots for months only head

Opportunity offering at Subs
5 times - boats too
close -

3 English War ships
sunk at Dardanelles by
Turk sub - because
English boats had
unscreened lights - not
screened because surrounded
by destroyers -

Falkland battery. Germans
made wonderful shots
at 10 & 12000 yds
Salvos accurate

English subs try to get between
Enemy & the shore

A destroyer (German) didn't see
an English periscope 6 inches
above water when within
100 @ 140 ft - German didn't see
periscope.

English have cons
& fans with oil - gives immense
black smoke column 40
ft high - have 6 boats
thus fitted for use on
Dardanelles

May 25 1915

Foreign boats which formerly
painted our war color
now painted light grey

May 15 1915

Masts shortened on all large Italian warships

all top masts struck below

large radio mast needed in Adriatic – visibility of ships decreased by cutting down masts –

In England

Tetra nitro-Aniline used to some extent as primer or booster for explosive charge for propelled torpedoes El

not used to great extent because rather dangerous & may not stand shock of explosion or heat.

Tetra-Nitro-Methylaniline is used for same purposes to a much greater extent

Speaks of a German torpedo which goes certain distance, turns around & comes back. Has an attachment that gives a chance of hitting – done with guns

Germans at Falkland Islands always fired after English as their smoke interfered with English spotters, 12 @ 16000 yds

the coal was from Iqui

Why not Chicago near by but not enough to prevent shooting doing it by dumpling system

Says at these distance Range finders very little use & range finding challenges impossible on account of great range & difficulty of observing

OOd

Firm was conducted from fore top during entire battle.
Ship steaming down wind most of time — Smoke from funnels & Conduits interfered with range finding

2 officers necessary aloft one at forward end & on at after end top as splashes from Enemy's shot frequently shut off view of one or the other but rarely both.

large quantity water thrown over ships by Enemy's shot & Control at top frequently wetted, Command keeping off all glasses necessary also hurted sights.

Bow Wash was point of aim but not good one as it was hardly visible

Enemy altered his Course 16 points several times & premitted our some occasions necessary stern for bow. Careening & Expansion at no time was center part of Enemy's ships more obscured than bow or stern.

Director system not used but it would have been of unequal Value as smoke at times seriously interfered with laying of guns of two turrets.

Voice tubes to top wrecked, flex voice tubes expanded on deck near Conning tower entirely wrecked by blast of 8.2 shell like 2" copper tubes in same place not wrecked

Telefone to top Control direct to Each turret officer OK & was invaluable

Spotting against one Enemy ship difficult she Zig Zaged

Changes of course could not be detected & continual sounding was necessary

---

French Cruiser Jean Bart torpedoed at midnight, but she stopped to examine papers of a 3 masted vessel

Radio out by

(Why not some sound app + battery on top mast? ed)

April 15 1915

A German Sub Officer reported to have said

1° greatest danger to be avoided is being rammed.

When periscope 1st emerges danger is greatest as sub can be rammed before enemy is seen

(Why? Water falling perhaps ed)

Subs Cant attack British Transports in ~~Channel or~~ straits as they are absolutely enveloped by destroyers

---

Russians use 2 balloons for fire control of Warships

In landing aeroplanes at night, ~~[illegible]~~ ~~day~~ impossible to see down more than 50 ft - landing place powered with gasolene + lighted, but this proved dangerous but now 6 CP Electric + Dry Cells used weighing 4 lbs -

---

German Subs - periscopes painted grey Recognition marks on top of periscope such as a Seagull

Apl 25 1915

German
says easy to hit vessel on a straight course, extremely difficult when speed & course changes — Same informant says when sub on bottom men cant sleep on account of the swell —

March 1 1915 speaks of use of big depth bombs for submarines

Nearly all torpedo hits from submarines been made when vessel less than 10 knots & at less range than 1000 yards

E.g. [redacted] was only 200 yards from S 126 when torpedo which sunk the latter was fired no marked concussion or other effect of explosion was noticed in the Sub'M & the

pressure indicator didnt even flicker. U 9 reports similar data from torpedos fired at 500 yards

Formidable torpedoed 2 AM — Full moon —

English at Heligoland fired many torpedos from subs without a single hit. The Germans were cruising at high speed —

Says French subs no good as they carry their torpedos aft side & cant lie on bottom at night as British do — In rough weather subs have to keep under way as waves bump them on the bottom even in 20 fathoms
(Dont believe it Tom)

German Sub. tried attack Magulons off Zuibaggie, but water too shallow & could not get within range

British destroyers rammed German sub at 10 knots & dent sunk sub but bows of destroyers damaged.

Battle off Coronel.

Sea rough, ships rolling & pitching badly so as to interfere seriously with shooting

Germans at Tsing Tao used illuminating shells but not much value as illumination too poor

Density of mines from mouth of Thames & Scheldt 3.2 per sqr mile

Many British Cruisers been fitted with spars 15 ft long secured underneath the bow & projecting downward & outward with idea exploding mines before latter strike hull.

Time to make a German Torpedo 4 months, weight TNT 180 Kilo

March 1915 - Many experiments with aeroplanes carrying torpedoes Range 1000 ft. 14" dia wt 750 lbs but accuracy of forming bad

Utilization of Extensive English Experiments made - Germans also

Moving Picture are taken from aeroplanes - (secret German process)

Krupp has aeroplane bomb which doesnt Explode by impact but when the speed & air pressure reaches a certain amount

Germans drop an aerial Torpedo, 20" long 4" dia TNT in head & percussion impact fuse. Gas has slow burning powder & a turbine, This gives high vel & rotates shell.

End of March 1915 to Oct 1 1915

Russian deep aeroplane bombs weighing 1080 lbs one bomb, Equivalent Carries 2 of these Bombs & 4 men

Big shells from Monitors bury themselves in sand dunes so deep before exploding that they do little damage

Some French ports difficult Entrance sometimes ships piled one on the other from submarine sinking

Germans lay 40 mines in groups. Clockwork only lets up a group, if these are swept away by sweeper another lot pops up soon

1915 –
Trawlers are sent to trail
Microphones astern while
on station looking for
submarines, other vessels
do the same

English Oct 29 15
used oil on sea
Smear periscopes
English have extra glass in
front & then remove it to
get rid scum –
Says dirty water –
harbors are bad

English all water of
sub was last boat
& go ahead drop net
Nov 26 15

English Sub. Mine layers
Carry 12 mines 3 ft 11 1/4 inches
long 21" dia

Italians use X ray to
locate faults in steel,
guns etc – great ease

Relining guns – placed –
Hot Paraffine & interior
sprayed cold liquid &
tube pulled out, new inserted
& then inflated

Wireless telephones used in
Italian fleet. Marconi says
very successful –
Dec 8 1915

Italians say Explosive effect
3" Aeroplane gun must know
direct hit to be of any use
should be larger gun,
say don't think Shrapnel any
good for aeros all favor
high Explosive shells

Search lights no good to
detect aeroplanes at
night,

English trawlers 2 drag a
net so arranged as to spread of
boats & length of net that it
reaches near bottom,
in net is Calcium phosphide
bulbs - When sub caught
boats cross cross &
Tangle up sub & phosphide
bulbs burst & come to top light
up

Jany 7 1916

Periscopes on English subs —
raised & lowered by Motors

English torpedo in Baltic
got within 200 yards Exploded
torpedo & shock dangerously
injured English sub —
up to this date English
had no Frazerken attacks
Canadian boats just
arrived surprised English

English sub running
under & close to a Traveler
Decoy when German
sub appeared Englishman
let go torpedo

German Subs Diesel 400
Revs min

May 5 1916

Fuel tanks used on German subs exclusively
plates 15X18 – 55 plates to
a cell in largest boats
independent tells used & installed always in tanks
idea small units was ease of repair & replacement & less breakage & losses & less due to vibration of boat,

Plante Pas used

Austrian Dropped bombs on Venice – Moonlight, Could hear motors but could see nothing although arc lights going –
Guns minimum at night searchlights only help them

Italian officer suggests only weapon good at 2000 yds is machine gun & if it could be rotated in a circle it would do the thing –

English Subs have broadside tubes
Commander thinks most important 8 tubes 4 in tubes 4 aft – 21"
Stay out 1 week in English Channel
50% of shots are broadside shots
object broadside tubes cover much more area without maneuvering
Commander 60% make hits in practice – but get on close as possible –

English have steam
Private Subs – 1200 HP
2 built 14 K submerged 21 Top

These boats can run 3 hours at 9 Knots submerged

Ventilate with Vent pipes to Loading Compartment.
Sailing Water in Tanks — no distilling aft on board — Boats heated by Elec — Cooking dittto

Periscopes not located in Conning Tower —
Walk around periscopes used
Magnify 1 power

Range finder, just graduation on periscope glass

Conning T armored 3"

Submarine Bell for signaling only Arrow built Subs have essential.

E boats take 8 or 9 minutes to get down

auxiliary lighting Portable Storage batteries Like Hubbell but superior, thank to a lead battery, since ever been using a lot of deep cycling flashlights

They have a gyro repeater so it will reflect thru periscope

Batteries are Chloride 3500 amp at high rate

Dont use individual Voltage leads; but believe in them from running interconnection batts

Use only 1 motor on shaft
Radio masts cannot be
set up from inside of boat

Jany 24 1916

German areas fly in
Column 6@10 miles
distant, wireless 20 KM but
Exchange & repeat messages
& thus reach any
distance

German have a searchlight
Can read newspaper 1000 meters
use storage battery - very
light Reflector + all Carried
on breast of aviator (not battery)
Ray seen 20 K Motor Extra battery carried in pocket
airplane wing.

All gyros on Torpedoes uncertain
Eng Dman, Italian

Ration headers Newspapers
rolled up dipped in formaline
+ burnt 20 minutes made
by Woman all over Italy
used in France Extensively

Jany 1 1916

Italian parliament
Criticism Italian Navy for
inactivity - Harsh words
used

One Case Bombardment of
Durazzo, Italians knew from
Cables it was to take place
yet did not notify Either French
or English, later heard of it
accidentally + started but too
late - French have great
Contempt for Italian Navy
There is no doubt about Class
treats - Navy slang in port lets friends & foreign
friends

Reason Sharpnel no to hit aeroplane is they are only a prolongation of the Trajectory

Jany 22 16, In France plans for subs have been definitely abandoned

English heavy nets -
Dover to French Coast.
Portland Hill to Cape La Hague
Mull of Cantyre to Ireland
Carnsore point Ireland to St Davids Head - S Wales - descend to depth of 300 ft - filled with gates permit passage of vessels

Microphones used near Paris to detect aeroplanes & Zeps

Jany 18/16 - One boat collided with boat loaded ammunition sea Marmora - Exploded terribly

Gyros in Torpedoes are OK for 2 minutes only -

Feby 3/16

Prounuda Dyalan interior w Communist now Employed in French war Ships.
Very satisfactory

7 men on Goeben ~~lost~~ ~~killed by~~ Killed by poisonous gases from TNT although worked to hospital then shortly dead

Aeroplane Light
German -
7 Cells Sammler battery
Osram incandescent short life
50 hours ? weight battery &
housing 4 Kilograms
battery can stand on its head
without loss of electricity
Signal app & cable weight
1 Kilo

French aeroplane drop
a bomb containing
information letter -
on sticking fault inflammable
material ignited showing
attention to volume it was -

Feby 14/16
Curtis turbines in Italian
Vessels not popular -
Turbine Rescue bad
Vibrations when Zig Zagging

Feby 24/16
English use 5 + 6 pounder
guns against Aeros + Zep
Effect pathetic + ludicrous - Mg

Allies have device
to locate radio stations by
turning ship - Caught one
German sub lies in ambush

Feby 14/16
Comdr-in-chief German Navy
retired, (Was a chump)

March 6/16

Falkland Is Battles. English vessels all short of ammunition —

Elec lighting unsatisfactory 1st shell put out all lights due to breakage of Carbon filaments use Hg Vapor lamps now

Dogger Bank action —
18000 to 19000 yards spotted by aeroplane 2400 rounds
60 hits —

over 3000 Trawlers now wkg —

Elec boats built my workshops generally sunk on 6th round open seams —
only 120 ft boats any good

says Germans losses of sub to Jany 1916 — 126 —
doubtful cases not counted
26 British subs got near Heligoland & submerged, German not suspecting Canna sent last sunk, British during same period lost 30 —

The 10 German boats delivered by Vickers from Canada have no proved very unsatisfactory several are at Gibraltar & out of Commn & several others in British ports recommng new boilers

The one successful boat is the Monitors 15" guns one torpedoed but OK room repaired

British navy March 16/16

four Light Cruisers 3500 tons
all steel. 35 @ 40 Knots
+ fairly heavy armor
+ a 120 ft armed patrol
boat beam 17 ft 6 ft draft
20 Knots - 2 of 3" guns +
torpedo launching apparatus

Curtiss + Engine have
proved most unsatisfactory
& now only used for instruction
40 laying in junk

Thomas Machine worse

Explosive tests on an old
ship in Amer Navy
didn't break filaments

Italians filled an old battle ship
with Cork then went to sea

English have surface
cruiser - 1300 ton one or more
3" or 1 6" gun to send she
has Barcelona

Needs Allies propaganda badly
in Spain especially
Barcelona

Aquitania & Mauretania mechanism
not efficient as transports,

Germans have an Aero Muffler
large bolted horn with gentle bend
4% power only lost

Mch 11/16

Anti Rolling Gyroscope furnished by Sperry for new Italian warships

French use little pendulum in front of eyes of aviator with circles so if he gets in Cloud he can keep level -

Denmark Coast English had a Submarine wrecked E 13 due to failure of Sperry gyro to function properly

Loss of Voltage is used to have Curved Error in Compass readings -

April 5 /16

Bat Gannon rocket go up 500 meters

Hungarian inventor offers USA to produce rocket which will go up 2500 & large ones 5000 meters -

English Elevedavis all enlisted men under Army - Navy gets them from army

Italian Navy 24 ft Balloons propelled entirely by Storage Batts

30 Tons displacement

25 miles radius at 5 Knots - Coast defense

4 men 2 torpedoes on deck dropped from slings

also 6 more 40 Tons displ 200 miles Radius Gasoline Eng on deck to chg Balloons

2 18" Reclaimed tubes
sent by railroads -

March/16 - whole West Coast
France heavily mined by
Germans - land by neutral
Norwegian & Danish boats
worked by Germans -
~~[illegible]~~ these boats bring
Cargos to French ports &
when going out drop mines
from bottom of ship -
French are on -

April 14 several gas
Explosions lately in English
subs. due to inadequate
Ventilators & Carburetters
E 30 was charging batteries
& Ventilators were not properly

opened - man pulled on
Charging switch, arc caused
an Explosion Killed 4 men &
seriously injured several
others.

Italians have periscope
raised & lowered while
observing - Chair wheels
around

German Periscopes
$7\frac{1}{2}$ meters - dome panorama
10 meters, telescopic coated by
Weston

Upper part periscope much smaller
than lower so cut down easier
better 70 M - lower 150 M -
latest is they have very smaller part

April 19/16 French introduced
Square nose shells for depth
Exploding against submarines

Illuminating material for
illuminating shells
Perchlorate K Sulfur
Aluminum 6% carbon
what % 1st 2

1917

July 1917
British Sub-K 5
Steam drum 22 Knots
6 Knots submerged 50 min 3 atm
340 ft long 2,200 tons
1700 tons on surface
8 tubes - 18"
Stacks telescope into boat

Hawkes

1917-July Arsenuretted Hydrogen
troubles on submarine
Use mercuric chloride
test paper - makes yellow
spot. Gutzeits test,
paper dry
Drop a drop of 5% sol
of mercuric chloride on
center of piece thin
unsized filter paper
4 cm sq - dry before
using - apply in Enclosure
Dwat or bottom over
space

Arsenuretted Hydrogen
is nearly as bad -
both are regularly given
off as English French day

SbH soon decomposed but
AsH is stable,
Arsenic introduced into
battery by the H_2SO_4 is more
dangerous than arsenic in
the lead = Antimony is always
in the lead

In chg battery arsenicated
Hydrogen is not liberated in
battery Except in very
small amounts almost
all being deposited on
Pos plate, During discharge
the dissolved arsenic on
plates partially
redissolved in solution
but at same time it
gives off a little
arsenicated Hydrogen

The quantity of AsH given off
on discharg is much smaller
than the period of chg

to purify French circulation
air through porous Column
impregnated with
Silver Nitrate 5% sol
PerMang K not so good

British French all
have radio direction
finders, Orient aerials
work within 1 leg (1°)
those stations, not ships
Can locate a vessel
using her own radio

July 1917 - Subs don't like
let Torpedo go until within
600 yds -
The smoke bombs thrown
from attacked Cargo boats
hung 5 ft above water
sub would get into this
smoke base because
of Ships or couldn't fire
torpedoes above reported
by an officer on gun sub of
a Cargo boat (Amen)

March 1917

Dated Dreadnoughts
from Experiment at
Jutland - has 2 chains
with Kites, at bow -
When thrown overboard
Kites spread out + catch
all mines except those at
bow

Has false sheet outsides
6 to 8 ft out 1/2" steel
with Tubes Containing
Compressed air - for
torpedo protection

German subs will
Torpedo close in so guns
Cant be used when ship surprised
or at long range

Means for handling cargo at Swanpool docks rather limited, no Electric trucks or means for rapid handling of Cargo

One reporter didn't believe in zig zagging with slow speed ships -
dusk hours most critical to a well armed ship -

Days Sperry mine (Depth) rig only 50 lbs
English 190 @ 220 TNT better -
The Draw bar, Spring

Trigger Striker Mechanism float of Sperry mine - Complicated + Expensive, Can be descarded -

3 12 Knot Iroquois Gellar than 30 Knot Lockaper for Subs - with Master depth Counter -

German subs able operate even in very rough seas ship has no advantage

Life boats used as decoys for Skimmers

Lights at night put on 5 seconds every ~~3~~ 5 minutes closer to Zone of 3 min further out

This is signal enough for a Raider to close, & even a Sub near our track to get close enough to fire at ships - Master was frequently warned after says:

Phones always pulling out order -

Phones full salt, loose & broken connections, Cords not weatherproof & no spare parts.

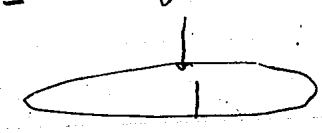
All this on a merchant ship -

Azores full programme

Steamship Virginia - May 3/17

Saw wake of torpedo - Turned 90 & evaded torpedo 15 min after a Sub appeared astern 3 miles away & opened fire, Escaped after both fired shots all missed by superior speed -

Its not believed Subs can operate ~~on~~ off Mexico on account of high water temp 82 in June & aug 90 -



Race

periscope lines to give impression of sub going in another direction

July 1917

Vessel attacked 8 pm by sub with gun fire but visibility diminished & Vessel Escaped

So far 8 Cases torpedo Explosion throughout sub –

German sub prisoners Captured report 2 screws, submerged speed 15 K – surface 21 K

Most of U-6 crew done on surface in rough sea Top Conning Tower hatch closed automatically & is kept open while Cruising all other Hatches being closed U 60 appeared

to Cruise in a well defined destroyed & to Cruise about the sides of a square always in sight of land Every day sights were taken at 8 pm – by ships clock. Wireless received & messages sent.

Cruising on top very rough & uncomfortable but very steady when submerged at one time U-60 submerged 2 nights & 1 day on account inclement weather – for 3 days prior to arriving at Heligoland U 60 Cruised on surface & sighted no vessels a Zig Zag Course was taken & Comdr seemed to have no guide of any kind by which he could direct his course

through mine fields.
Saw 200 subs at Heligoland
All this occurred before March – this report is dated July by Naval officer

Aug 1 1917 Comparing data
French Expts on one of their subs submerged
22 K gun Cotton depth bomb – 10 meters submerged
bombs 10 meters depth
6 meters from Hull –
branch was affected –
then various distances
~~at~~ beyond 14 meters

sub could navigate.
13 to 10 meters sub had to come to surface slight leaks & broken rivets, & damage to interior app
at 7½ meters had a bad leak from broken rivets & open joints.
Old sub & thickness 8 mm much less than modern subs

English Howitzer for bombs for subs –
7½ inch Howitzer
Chgz 1¼ lbs MDT – 15
Cordite 13.
projectile 100 lbs
burster 43 lbs 390 ft seconds
1420 yards also have
11" Howitzer burster 119 lbs

High angle fall to stop
ricochets - also reduced
charge -

Rubaloon used in
trench gas bombs
Chlorine
Phosgene
Hydrocyanic acid
Chloropicrin
Arsenious Chloride
Chloroform
+ Mixes of these

Lachrymatory Shells
Ethyl Iodoacetate,
" " 75% Alcol 25%

1/10 free space

Trench Illuminations

Very pistol Elevation 60°
reach height 100 yrds
before ignited - filled with
mix of Aluminum 20 parts
Barium Nitrate 64 pts
sulphur 16 pts Compressed
into an aluminum tube
the fine meal powder being
added direct on the ends
ignited both ends must
not leave behind a trail
of light 1" Calibre
Have also parachutes

Use also flares in trench
so aeroplane can see them -
Evening Cant used for
signalling
British use 10 million a
month small cylinders 1½ tall
Easy broken open & ignited by taper or
ignition cap

Red Strontium nitrate 70
$KClO_3$ 10
shellac 15
Calomel 2½
sulphur 2½

Green $Ba(ClO_3)_2$ 25
$Ba(NO_3)_2$ 55
shellac 20

White BaO_2 5
$KClO_3$ 17
Al 30
$Ba(NO_3)_2$ 55
shellac 20

Yellow fuse at night —
$NaNO_3$ 70
shellac 30

all used day or night
When used days no smoke should come off

Colored Smoke —
Employ certain kind of dyes in smoke —

Red — Oil yellow 14
Lactose 10 pts
$KClO_3$ 11

Yellow Auramine 14
Lactose 8
$KClO_3$ 11

Blue — Conc methylene blue which contains 20% Dextrin is only one that works satisfactorily
20% of this — 9 lactose + 15 $KClO_3$

Purple — purple dye 50
Lactose 20
$KClO_3$ 30

These are used in 3" mortar shells

Smoke Barrages

Says phosphorous is unquestionably best substance for this purpose

Red –

Tin Can 5" x 3" mix of red phos lumps 70 pts 1/2" mesh.
11 pts red phos powder
fired by NaS detonator or time fuse

Cheaper:

Pitch	30
$NaNO_3$	15
KNO_3	30
S	12
Borax	9
glue	4

Pitch free of volatile oils heated then 350°C
put up in 2 1/2 lb water proof Cans

With strong Container

Pitch 26
Tallow 9 melted + 34

~~[illegible]~~

$NaNO_3$, 14 1/2 Coal dust 14 1/2 Sulfur 2
Stirred in –
Poured in Container gives excellent results —

Convoys from America don't work sometimes –

British have order for all Cargo boats Zig Zag night & day in Zone which varies the speed while N of 30N & E of 20W & in Mediterranean

At night one Cargo boat
fired at at dusk
missed, torpedo
afterwards found light got
out from a port cover
swinging in & out
on its hinges ~~[illegible]~~
Sub a chance –

One Cargo boat armed
Amen – Exide battery
no hydrophone & any apparatus
& telefunken rather.

Spotters are all in Crows nest
some wants nest higher

One Cargo boat Capt
got in fog & started
blowing fog whistle
ship was making 18 K
(Amen boat)

25 men Amen short leaves
Liverpool 4 gun supplied
Complains vessel short handed
perhaps premature –

French Convoy Amen
Transports 16 knots slowing
them down to 12 ½ K
Convoy French boats being on 12 ½ K

The Germans will probably have
in Spring large Cruising
Submarines – no torpedo
tubes but with 2 15 cm
7.1 inches – Very high speed
Extended radius action
Very limited speed submerged
Overheard by Norway prisoner
on German Sub – May 1917

Subs keep in the glare of the sun – 6 10 am –

Top of subs (gun) painted light gray –

Torpedo struck boat but dont explode on striking port door examined bottom & found no damage

2 torpedos fired in Mediterr
On dark night one failed explode passed under the other missed.

Got wrong book –
Now return to 1916 book

October reports

Apl 19 1916 –
Torpedo boats in search of subs steam in Column 1 & @ 20 boats on lighting sub periscope one leaves, dont go direct as Germans throw out a dummy periscope with bomb attached this caused loss of many ships – but go way ahead then drop depth bombs 20 kilos weight, drop several, they explode at 8 meters –
note reports in 1917 show bombs

One reporter says German U boats change their numbers from time to time -
(We just as I thought French & Eng fell for this change as Lusitania May 1917 -

& the above report was dated 7 1916

May 25 1916

Commander of British flotilla at Venice informed Admiralty he knew of no device for detecting Hydrogen in Subs & believed Had British had no such devices said accumulation of gas was primarily the fault of the personnel, from not properly ventilating but stated accumulation of H was one of the serious conditions

which still arose on their service, & one at present unsolved he said several months ago a great rumbling & serious explosion from H

Germans say a surprising large number of English Navy shells fail to explode - ditto overhead guns & great drop given large dispersion - since 2/16

British Commander long experience with Subs at Venice say large subs have no difficulty riding out severe storms at sea at Heligoland Bight impossible to rest on bottom. at depth 60 ft or more as severe motion during heavy weather caused up & down motion -

Italian torpedoes range not over 1500 yds but have high speed 95 Kilo TNT – large torpedoes 6000 yds 115 Kilo –

Torpedoes

Must be taken ashore + broken down every 45 days. (1e) Those made at Whitehead factory at Fiume – reason is that vibration about vessels Easily derranges delicate calculations machinery of Torpedo –

French use small fishing Sailing Vessels 1 sail & steel nets like fishing nets, Cover great area + already caught 2 subs –

French have a small Caterpillar Motor ~~with~~ small brick 2 ft wide 4 ft long – 3 systems of wheels linked up to Caterpillar system of propulsion on either side of the platform raised up 18" from ground there is a Caterpillar system of traction in front of the platform projecting out from the middle there is also connected up to a 3rd system of small wheels also with the Caterpillar method of traction, On top of platform there is a 1/2 HP Electric motor + in rear of that a reel of 200 meters of Electric Cable, Gears are actuated by motor + all 3 of the Caterpillars actuated same time. Machine will march straight ahead if right Caterpillar + one in front is actuated Machine will go to right + similarly to left. ~~of~~ Motor + Caterpillars Enclosed in armor forward is a projection slightly inclined from Vertical towards front of machine

to an iron post 2 ft high 1½ inch
dia on which is fitted the
ordinary type of aerial torpedo but
has 200 lbs Melinite –
This torpedo can be fired or projected
from machine by means of an
Electric Current firing primer
of the propelling charge in base
of torpedo –
They put the machine on side
of trench then men in trench
direct it across No-man's Land
upon arriving at barbed wire
Entanglements Machine is
stopped, Control made torpedo
fired – Machine then brought
back or reloaded
Primary use for attacking
Machine gun Emplacements
Reputed to have great success
on the Somme, he saw it fired

200 of these machines & knew
that at least that number
was sent to France
Can travel over worst shell
hole ground could climb 45°
Its been kept very secret
July 13 1916 –

Italians have a multiple shell
1st explosion throws out (32 CM shell)
560 subshells with effective radius
of 300 metres or 600 metres dia
using common powder ~~Ito~~
The subshells are timed,
14 CM shell radius 100 metres
been tried & worked OK

German Subs Ventilation 28 July / 16
Captured, bat compartment
Ventilated by supply & Exhaust
Exhaust Outlets multiple in
Close relation to underwater bottom
to collect & drain of H_2SO_4
to run rigorously while on surface
~~pos~~ Multiple outlets for exhaust
Ventilation not used on English
Subs in bat compartment
dependence placed on a single
or a double outlet drawing purifying
not employed –
German Sub has very complete
air purifying app by Chemical
means & for O_2 removal from
Cylinders Use cylinder
NaOH – Shelves & trays change area

use O_2 cylinders
No Hydrogen detection –

One British Sub was 36
hours submerged & men OK

German use pneumatic bomb
Wrocwen 8" x 30" cylinders 3000
lbs pressure for air – propelled by
Mortar, Very serious funnel
shots 300 meters fall within 3 meters
No noise or smoke

Torpedoes German use long
pipes & pump air men wear
masks –

French use microphones new
devices & trailed astern
like a patent log. better than
outside of ship –
When ships clapped they hear
Subs 10 Kilometers
British discard long micro &
get in special sea
Blind men employed to listen
as they are 25% better,

Its said Every German ship has a fog producer in which it Can screen itself.

The Mayer Auto gun
many barrels different angles
Covers big area around
Takes, 800 per min -
French & English have
20mm reconnoitered formerly at
depression of
1000 yds 300 square meters

US pat Aug 1915

Its dispersion Effect would largely Counteract unsteady gun platforms -

Its said 10 German Subs built per month 5 on average
Aug 21/16

Germans are using Collerd Electric dust & smoke devices on their ships to stop smoke

German High sea fleet drill & fire at night with powerful search lights at buoys -
moving full speed

Firth Co of England have a fuze which nothing against the Cannon of a dirigible will explode it - (probably friction moves a thing sideways - Tel)

Italians made a special arrangement to get drawings English that so highly of it that sent it by special messenger under a guarantee

French air Bombs have an End only 2" long

Work of scientific men

Sir Jos Thomson stated
the Francis scheme for detecting
Subs will not work

a microphone device will however
detect a sub several miles
but its efficiency is greatly affected
by Temp of water

Sept 28/16

Gustave Zede French sub
Boat moored alongside Quay
wall at Cherbourg. Recharging
Battery, Hydrogen gas given
off Caused Explosion nearly
Completely wrecked interior of Boat
As it was night only 4 men on
board the others in barrack
the 4 men were Killed
Estimated 6 months to repair

French Pay out harbour in
Squares & another a ship here
& Hydroaeroplane search for
Mines & Clears them up perfectly
Section after Section while scanning
others Carried to Round by Enemy
Mines are 23 ft down but
in 300 to 200 ft of water

Flak gun is a machine gun
3500 Meter range has bullets
fixed ammunition 6" long
in belts like a machine gun
5 gun Accord

"Flieger Abschuss Kanone" is
name German gun for Shooting
Aeroplane - height range 2500
Meters

German warships bottom of hull
painted darkest 2nd part lighter
upper works still lighter & spars very
light. They say lower part of
Hull is seen against water & upper
part seen against sky

Excessive vibrations of submarines seems to be a general Complaint, running on top –

They do have a periscope Rangefinder but experimental as yet,

Nov 2/16 –

10 German destroyers made a raid in English Channel at night & sunk 3 destroyers English (fully used searchlights 7 of)

Germans in 1916/ held Russian line with only 880 men to the mile on front trenches

Large number Explos on smoke bombs made at Toulon Nov 16/16 by French. projectile was phosphorus use guns & Machine on boats nothing further learned bout French thought it important Jutland battle Germans used smoke screens the sound which explosion frightening of English

In order for a sub to torpedo a Cargo boat it is necessary for sub to place herself well ahead of oncoming vessel & in this position it is impossible for sub to see if Cargo boat is armed

So far 12 armed Cargo boats sunk
to 16 unarmed

Aug 15 1917

German smoke apparatus.

Dense white fumes is produced by bringing quicklime in contact with Chloro-Sulfonic acid

Lime is in layers in bottom of a cylindrical tin 1 ft dia & 3 or 4 ft long at upper end is spherical container which lets acid drop on lime; it has handles in to carried about

Tracer bulets - phosphorus inside bullet at end bullet is fuse like match plug which melts by friction on rifling of gun ~~the~~ phos escapes & ignites & burns throughout its flight leaving a special trail of smoke

Germans in many occasion or surface clear fog 8

All English subs off Irish Coast paint their upper work dirty white in order to match the sky background

All men on watch wear white clothes & say gas in suits generally sighted before they see English on account of this point.

(?) — English don't like their guns say mustard would rather have a Lewis gun

in long daylight season
they have to submerge 20
hours out 24
Use Lime for CO_2 in trays

Say no partition boats
ok for 20 hours but the
partition boats last 5 hours
men gasp for breath

Listen at night on radio
never send -

D + E boat batteries
worked once month
batteries nearest blower
intake vacuum most weeks
not filled with seperate cell
Valve Leads

Hydrogen question seems to be
ignored, Officers not impressed
with danger take no precaution
Chg 450 amp Tapering off by
Thumb rule & never getting a
full battery
D3 had a crew last fall
body knocked out by
Anaemic H.

British Subs have large
Bow rudders

Some British 1/2 or multiple
battery & go 3/4 Knot speed
giving great endurance when
submerged on patrol

2 German subs work together
1 Does by other watches

~~August 15 1917~~

1st Sept

British using placard torpedoes. thus guns greater range do not leave so clear a wake

No doubt the Vulcan smoke box well hide a ship, but it goes out a flame, but is to hard it to meet boys throwed overboard NG

One Cargo boat saw a walking stick periscope after a torpedo had been found 600 yds distant it was painted Color of sea & the ~~Scan~~ he never would have seen it if the wake of torpedo hadnt painted it out

Intelligence of —

Up to Nov 1 1917

See End book

Torpedoed unseen	12	11	||||| |||||
Torpedo wake seen no Sub	8		||||
Torpedo wake seen afterwards Sub seen	5	11	
Sub seen, then torpedoed	5	1	
Sub not seen, then recognized, sunk	6	11	
Sunk at night	2		
Saw wake of torpedo turned not sunk		4	11
Sighted sub before sunk	6		

Sept 15/17 —

Convoy 5 Strs — Convoyed by 2 destroyers 2 Trawlers Speed 5 Knots — 1 Boat torpedoed — ~~Later joined another convoy~~

Another Convoy 10 Knots speed 3 destroyers 3 trawlers & armed yacht. Attacked & one str torpedoed next day 2 Strs torpedoed Trawlers went to rescue of Crew & Destroyers went for Subs, 6 aircraft & 6 boats made off as fast as could

This attack was considered exceptionally successful & probably due to fact that German subs instead of attempting to cross large areas of Zone were operating in squadrons along certain lanes of traffic

Cargo boat abandoned after Sub gun fire. Smoke boxes used but useless not enough smoke issued from them —
6" gun arranged gun on Cargo boat,

Even the German Sub Commander said to a Captured Crew
" How could anyone Expect to get a sailing Vessell into English Channel without ~~sinking~~ being sunk
He asked whom the Thomson & Crosby were. American Espionage
Evidently send out sailings —
Said he knew the 2 boats sailed same time

Expts British

Sub. moored to buoy 12½ fathoms
Menu 250 lbs gun Collars 15 ft below surface 51 ft from Centre line of sub or 45½ ft from shell of sub at greatest breadth —
on Starboard beam at Centre of boat.
Fore Hatch closed Conning Tower hatch + Ventilator
Open periscope down —
Bridge uncovered
Port torpedo tube full
Condition as if running on gas Eng
Battery fully Chgd 5 p 9
1213

On Explosion - Whole sub
gave violent lurch about
2 ft in water to port

Didn't sink.

Many things wrecked.

After reaching harbor -
found Every Galley Container
broken up, and all out
of Cells ~~[illegible]~~ giving very
great heat due to oxidization
of neg plates

Sub not making water
but Hull slightly distorted
Motors shifted out of line

Thus Experiment is to see if
Mines 100 ft apart
will put surface running
out out of business

They are going to
lay mines this way

1/2 low pressure for age such it was
Calculated under these
Conditions -

English say most important
Torpedo shoved straight out
at its set depth at once

This feature seems to be so matter
which Concern Naval officers
much Concern They are
Experimenting with device in
depth chamber whereby
blast of air upwards or
downwards assists in
quick establishment of
depth - As yet but little
hope is felt for this device
that it will be successful

on war ships Sub watches
have 6 on the each end of Bridge
1 hour shifts, only observers small
section, - says observers on open cannot
keep properly alert,
Lookout Where a shit provided with
glass for bad weather
4 lookouts on each side of
Ship - & arcs do not extend
much further aft than broad
of the bow, English say this
lookout OK & evolved from
experience & satisfied with it
Upper bridge 80 ft from water

~~deformed bow~~

Higher periscopes on Eng K
Sights 2½ dia at top
mainbody 6½"
Lower Peri is 4" dia at top
its this that is used first

but when enemy closely approached
this is housed & small top peri used
Capt said in his experience he could
always get within 2000 yrds
of his own battleships <u>without</u>
<u>detection</u>.

English have battleship
torpedoes 18000 yrds at
15 knots,

German Subs transmitting
Range 50 @ 100 miles receiving
range larger
wave length generally
1.312 ft occasion on longer
wave length - latest subs
have much improved wireless

French say
from January 1 to Aug 1 1917

French boats successful
against Subs 106 Encounters
of which 34 Cases it was due to
manoeuvering to avoid torpedoes
& 62 Cases to use guns
Chiefly in reply to Subs
in 13 Cases however its warship
sub that started the fight
7 occasions Cargo boat
Chased Sub -
3 Cases Escaped by beaching boat

Oct 1/17

Another Convoy 7 Knots.

Another Convoy North Ireland
had no war ships of any
kind -

French Experts with propaganda
for firing at Subs -
7000 meters water Column could
not be seen for spotting
but when instantaneous fuzes used
OK & for further trials

Altitude of Hydroplanes
700 meters outline Vague
Should be less - say
500 meters

Big shells fired into Dunkirk from 17" gun do surprising little damage as the cone straight down ploughing thru the street but expending their energy in line of flight instead of laterally

Oct 15/17

English Sound Ranging finds

Have 6 positions with microfons 1500 yds apart, each total 7500 yds Base is placed 2000 yds from front line

Signals received from phones on a special type recording galvanometer capable of measuring 1/1000 of a second The time of flight to each the microfone is affected by report of the gun

In front of Messines at an advance is a man with key the moment he hears German gun he closes key, the waves then reaches microfone (although he gets a heavy bangs before)

time intervals read from record & geometrical deduction on map board

Position of gun & first of shell are found as well as this time of flight can be calculated & so the calibre of gun can in most cases be determined

Accuracy depends on weather & other sources of error, under good conditions error rarely exceeds 50 yds ~~the~~ can't work when wind of any strength is blowing

as report never reaches station
being deflected upwards by wind
Also interfered with when
large amount firing take place
& bombardment makes it
impossible

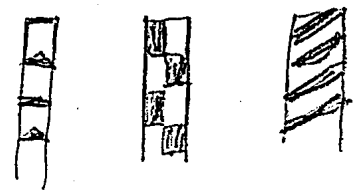
Microfone responds to guns
However faint as long as audible
is absolutely unaffected by other
noises such as speech & even
unaffected by suffering machine
10 yards

40 Miles wire used to connect
all phones & they are very
liable to be interrupted

The whole front in France
have the Second Rampart

This book shows Tables
of actual Experiments
Can be Copied

British & German Renscape
Camouflaged all kinds ways by
Paint, at Capt. Tadd.



Colors bright & dark Grey
some use light green — metallic
paint which is very satisfactory

British tow a fish or hydrophone
from destroyer, Use heavy
armored Cable 1 1/4" dia
a heavy weight of stream line
form called a pilot fish
which tows 200 ft astern
& 45 ft deep
The "fish" proper is 8 @ 9 ft long
& tows about 45 ft astern
of the pilot fish

the last 40 ft of wire has
a steel core & heavy insulation
of rubber outside of Electric
wires which surround the
core
Since the Hydrophones are of
a directional type the necessary
for them to rotate.
This is done by having 20 or
more wires running down towing
Cable into fish & connecting
to a local light device for
rotating the hydrophone in
Azimuth

Fish part 8@9 ft long 17½"
dia Cigar shaped
Each end air chamber
Fish filled with
water
says smaller fish ng

Fish has 4 vanes on Tail
says no water noises at
17 knots - filled with water
fish weighed 800 lbs & had only
a few lbs buoyancy
use 2 phones right angles
outside of ~~the~~ fish fastened
thereto with strips of 9
underwater d =
They had amplifiers & used them
when thought necessary
Use grain Carbon Micros
as it speaks of packing
have device to hit phone to
unpack
Eventually this is for
Depth Charge work
Elec Engineer talk showed he knew
nothing about diaphragms
Etc

12 Subs a month I gather
from these reports to the
Limit of German construction

Friendship
Slow speed when
submerged - Limited periscopes
~~Vem~~ horizon glass over Subs
in very precarious Condition
in efforts to locate, sight, and Crack
Subs of Enemy

Jutland battle, no German ships
Ever Explode magazine they
have Cordite fuse but no
Explosion - Yet British have
lots magazine Explosions
what have Germans got
S
14 German ships sunk by gunfire none

blown up
9 British sunk officials 6
blew up

British use my Smoke from
destroyers on disengaged
side to make it hard for enemy
to see, Reporter says something
in it, suggests it be rapidly
Controlled by signal

Sept 1 1917

"B" Class submarine is engaged
in testing Edison battery
individual group Vault Meter reading
are taken from groups of 5 cell
British officers are keenly
interested in Edison Bat

They have read the report of Board at NY Navy yard on Edison + Lead battery & in general are inclined to think Edison battery is an acceptable one for submarines.
The Claim they are not much impressed with the Hydrogen difficulty & that the Ventilation systems on board their boats, are entirely capable of coping for this factor
Then boats "B" & "E" ~~[illegible]~~ & subsequent classes do not have to float on the line in rough weather

Nov 1/1917

French say for seeing subs at a distance it is essential a lookout should be aloft - provided with powerful optical instruments
In order to pick up periscopes of subs ready to attack a deck lookout is necessary
Lookout should see a section of horizon from ahead to beam on each side, 137° on each side of ship. Must be particularly active in this section as it is most favorable for torpedo firing
(10) Either between 80° or 90° is most favorable firing distance 300 to 1000 meters

Says Zig Zag is only good if great deviations are made.
The above due to Experts

German Dub-
Discharg of Cadium

265 amp	20 hour	5300 amp	1.8V
480	10	4800	1.8
836	5	4180	1.75
1230	3	3690	1.75
1630	2	3260	1.70
2400	1	2400	1.65

Chg 200 amp
106 amp
Dead at 210 RPM

200 amp
63 "
" 120 "

Slowest possible speed of Motor
150 RPM Highest 350 @ 360
full speed 310
3/4 speed 280
1/2 speed 240
Slow speed 150
Current at 350 @ 360
2500 to 3000 amp
Battery Cap 10500 @ 11000 AH.
on 36 h discharge —

British Experiments
Depth Charge are now made only to break battery jars as this is the Easiest & most Vulnerable point as other points are not fatal although injured.

An officer in Mediterranean Explained frequency of torpedo hits & thanks its employed

Sub following a route parallel to ship attacked but on opposite tack then to turn out from this course at angles than 45 deg & launch torpedo from bow stern tube.

at the moment ship is passing

This maneuver is in fact much easier to execute when target forms part of a group navigating in line or about in line of bearing than when it would be necessary to attack with bow tube –

French have worked out our Zig Zag & reach same conclusion 12 knots no good.

English appear good gun on Cargo boats Gray cant work in stormy weather –

German Gunners afraid when starting out only get Heul instructions as to region to operate & these are not alterable – Mine laying Subs get definite instructions as to region to work

Mines always planted at night –

Worst they fear is Dirigibles Travelers next Seaplane & dirigible least feared anyway but bombs too weak to produce troublesome damage

Subs make little use of Radio for fear being picked up by radiometric stations

Aeroplanes & Dirigibles Can hear at great distances One heard 5 or 6 miles off

Attack on Cargo boats is most likely in Early Morning particularly in Early dawn

Convoys should have dirigibles they are invaluable

Nov 1 1917

Another Case Sub Kept her periscope between the Moon & Cargo boat.

A ship that got to Port after torpedoing had a hole 18 X 30 ft

14 Knot boat saw Sub - placed herself 6 ft Sub & Run & Escaped -

One Yanks Sub painted grey along water line - above painted in black & white squares

Norwegians say in April 1917
30 German subs trying to
pass via Baltic to North sea
got caught in ice & losing
one persisted as could rise
they were passing Narrows
submerged & pushed under
ice,

Some German subs carry a
small fog horn as a decoy
in fogs -

Days from trials carried out
by Patrol boats. Trained men
can hear by phone a sub
900 meters when sub
proceeds bow on at 2200 meters
when proceeding stern

a precision varying from
5° to 10° according to
distance can be counted on
Sun interferes as slightly heats
different layers of water
Choppy sea interferes seriously
Trawlers passing close by
interfered absolutely with
observation of the bearings
of the sub; without being able
to estimate the influence
it nevertheless was observed
that the revolution of engines
could be heard simultaneously
with the less distinct noise
of the propellers of the submarine

Nov 15 1917

Monitors at Lubeque

25000 yds shots from enemy gave surprisingly small splash on account of striking end on —
Sounds of Lubeque guns could not be heard,
shots gave little noise when striking water, projectiles go off when under water
probably on striking bottom
at any rate go off so deep
no evidence of explosion
visible from aloft. but thereon
deck distinctly has concussion
of projectile going off under
water,
Enemy do excellent shooting
Usually they use sound
triangulation, which common

onshore but new for ships off
shore if this is case smoke
screen serves no useful purpose
says accuracy of determining position
by sound method is astounding

They use oscillator galvanometer &
spot light & photo, several galv
on the sound measuring circuits
make straight line, when wave
from gun arrives this line
oscillates — another
device is recording on
smoked paper which is
much quicker

They use record of enemy gun in
conjunction with aeroplane bombs
can be done under water

British dont believe in
air wireless ship masts
Even their men meets they
are trying to break up in
sections of camouflaging

The wave length which Hydrophones detect under water is 18 ft

If Hydrophones are very near air buoyancy tanks in Fish

Question of 1/4 wave length of it they will have a good deal of sound Cut out

They propose to increase length of Fish to 12 ft – they are trying to get it down to 3 or 4 ft

They propose blocks of Paraffine instead of air for buoyancy –

The microphones being Embedded in the paraffine in this type they do not attempt to rotate the microfone but use 2 sets, one on each side: instead of Paraffine they may use a jelly like substance still Experimenting

Germans project electrical device into our lines & learn our future movements. We have been notified for some time how they do it – (Tap. throw in wires + hear by induction)

Periscopes Subs

Periscopes range finder.
Telemetric scale used with high power magnification — one usability used

large number of boats have periscopes fitted outside with Combined deflection table & telemeter scale —

Use Forbes log fitted with speed indicator

Wire sounding app used glass tubes, but accurate results can be obtained by amount of wire run out so its unnecessary use tubes on wire sounding

~~Aeroplane bombs due to wind etc 12000 ft. 80 ft out~~

Porpoise seems to follow submarine — 2 cases so far —

Allies use Carrier pigeons on their subs so not to reveal position by using radio —

English have a natural Hydrophones.

Navy only interested in Hydrofoils for boats for using Depth Bombs

So far no specific noise different from other boats comes from a sub principal frequency from subs 700 to 1000 cycles many other noises in water all about this frequency
what a few of them made by ship carrying the phone, hence own boats sounds must be eliminated.
At present must stop ship to use them. whereas whale about to get sub is to keep going
They say no trouble for repp to hear sub, but not when running this not been accomplished

Sub. sound different than Reg ships, subs slower there being no upper Rankills
They use Audions but trouble is Audions amplify the all sounds

Say its better to diminish sound rather than amplify this is result of Experience

Tried to break up slow sub waves by breakwater No

Trained Ear so far best picking out of Speed Made of the sound the Specific Sub seen for this have a detail with 120 men

Band men best blind men not a success

They low phone hammer not go too long for their hand to maneuver to drop depth only — Too close to boat phone on each side — to get direction

Use 5" dia diaphragm thickness at center 1/32 1/8 at its circumference

Have a heating Current in
microfoam to stop moisture
depositing on Carbon
granules

Can pick up Sub 7 @ 8 miles
(old type fish)
away. boat stopped -
Entirely free water noises
partition between phones not
much -

Proposed system hunting
4 trawlers in line 7 miles
apart Discharge 6 or 7 miles
in front or rear of trawlers
Armed gun, torpedoes, & explosive
paravanes, When sub
located & they think they

are on top of it trawlers drop
one depth Chg from stern
throws 2, (one on each side of boat)
similar depth chgs from her
Depth Charge Throwers
which send them 40 yards from
side of ships ~~depth~~ Two depth
Charges then dropped from stern
80 yards apart
They makes a circular
area 350 yards very
unhealthy
The Torpedo boat attacks if
it has a chance
Have Tapers to stop granules
of microfoam pkg

All searchlights went out By at Battle Jutland, glasses smashed, mirrors broken & arcs went out

Arc lights used to see where shots fall rather than objects

Germans say now they can torpedo ships from seaplanes carrying torpedoes, claim to dread a torpedo from subs.
also dirigible torpedoes controlled from shore, have them at Zeebrugge. One was hit by English Monitor

Americans use a bomb to throw a wire to intercept telephone messages

British have 80 ft wireless controlled motor boat 25 mile radius.

Are experimenting on a sound from sub device to set off depth bombs
Sound detonated mines, goes slows actually tried it when came near mines it exploded them. High speed boats don't.

German uses pendulum, Fire control is automatic on every big gun mounted on insulated, which forms the gun when in correct position,
Pendulum uses 2 Tiny Communicating Cylinders Contain oil. (Castor oil)
Whenever rolls pendulum gives exact vertical line
Consequentially horizontal a base is thus obtained by which gun can be given desired Elevation
Range got by Barometer

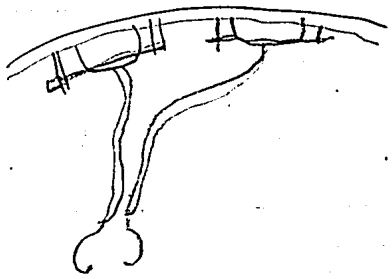
As long as the angle of Elevation is not correct an Electrical Connection between Instrument & gun makes it impossible to fire gun
gives 75 @ 80% hits at 14000 @ 18000 meters

German Torpedos
163 Kilo Tetrogh-
dia head 496 mm
Capacity air flask 520 Litres
Thickness 12 mm
Motherhood 4 cylinder

German subs have two small Diesels for charging accumulators - information not certain -

French have a phone connected to ship plotter at Base & listening tubes, heavy weight pendulum also a factor -
Hear while running
Det submerged 1000 @ 1500 meters
Surface patrol boats 2000 @ 3000
Detaching Dept. 3000 @ 4000
meters must be trained men to pick out from great mass of sounds

no mines used just hull of boat,



Jany 1 1918

Another place where difficult sea boats between under the sun —

German use 2 gyroscopes as best for long runs
one torpedo struck mark at end 10½ miles

German in sects use Microfons in ballast tanks in water
2 in bow 2 amidships 2 stern
all in same trunk
use condenser for damping sounds
They seemed to be tuned all to different

Current in Microfon 50 milliamp
Noisy machinery not used when boat running as could hear (1e) auxiliaries & Everybody must be dead quiet throughout boat Limit of speed of boat running Warning could the boat, use adjustable
Res to weaken when sounds too loud

Says things that

interface are

1 = Sandbanks, shoals & strips of land lying b/t sender & Receiver

2 = Sea Currents Especially if they are dif temperature from surrounding water -

3 Heavy seas

all of which result sound becoming faint or causing it to fade

also

1 = External noises, sounds made by boat, or sounds due to boat running

2 = Reports in microform or wkg

Jany 1 1918

German Subs have no difficulty passing Dover at night

German Subs have listening booths -

Say German subs have listening apparatus detecting sounds 5 miles only works satisfactory 3 miles

When pursued by vessels fitted with hydrophones Subs steer Zig Zag stopping occasionally to listen

supposed to be able to dive to 330 ft - When passing mine field go 65 ft When attacking go 36 ft

Subs operating in North painted grey Deck & boat bottom black Mediterranean green

Torpedos for German subs

Dia 19.7" length 16 ft 4"
Range 1200 to 1600 Yards
2 propellers, no heating device
not fitted with gyro angling
gear can be set for 16 ft
Carries heavy chg
only used against Coast Guard
will be hereafter furnished to all sub
its Not popular as large amount
Water is spilled on firing &
helps betray position of sub

English Coast Torpedo
1 55 cm but had a dim
stern light placed to show
3 points on either side
Was Zig Zagging at 8 1/2 Knots
(22 to show more lights)

In British Convoys the inside
Vessels keep both their stern
running lights burning while
outside Vessels have only
their stern lights & that both
American & Brit Crafts Merchantmen
& escorts are guilty of Continuous
Signalling lately blinker much
offensive to Commanding according
to this American Ship Capt
think no signally should be
done in clear weather & only
if any in rough or cloudy

On one occasion his ship was
in Convoy with 32 ships
on one night before Convoy,
out of danger zone he & his
1st officer counted planes
distinguish 23 vessels
His own ship had no lights
Except his altered stern
light

English have Kite Balloon with observer. They are a success, ~~the~~ man also uses flares at night to discover submarines last 5 min ~~effective up to 5000 yards~~ The short flares or star shells from guns on boat Effective for 5000 yards say very valuable

Delay is so sudden that it is liable to detonate TNT in shells stored on ship if struck by torpedo + Explode Magazine — Russians put shells on wood in magazine to stop waste, as it travels more easily —

Acetylene welding has been entirely displaced by Electric arc welding with Rosedale iron Electrode sommended with Tube of asbestos etc & are equipped with slag material to keep weld under slag —
all kinds munitions welded this way + all other wear appliances, are now trying varieties to get rid riveting
1 man replacing 5 riveters boilers Cruisers etc

Hunter should know this full report in my report
Intelligence Officer report

latest is that fish torpedo towed behind failed and no more expts will be made

No extension use of shore station sub listening devices has been made

Best phone is Walzer app as it permits listening ship under way - Ranges of sub listening devices which are any good at all seem to be about three or two miles more or less depending on orientation of sub or condition of water as to temperature layers

So far as we have been able to find out no careful expts in which the speed of a sub varied or expts to determine fundamental characteristics of sub sounds have been carried out.

It seems that up to date they have nothing practical

Transcript

Centrifugal bomb thrower

bombs ignite on breaking

use $KClO_3$ & sesquisulphide of phosphorus

ignition made against a corrugated surface made of compressed coal just after leaving machine

This tip is only applied to bombs at last moment

one soldier at crank 1 at small wheel + one or 2 to supply bombs to the funnel

English Balloon Kits
has photo apparatus in
dome, pull up + down to
develope

also for Radio Aerials -
But most important is
for sighting warships by
observer in Balloon Kite

Latest reports show many
sunk at night all in Convoy
showing that Convoys
have lights + when a
sub is in path they are

sure to get 1 or 2, sure
Our gyrolight will have to
be used. -

some Convoys run close
to lighthouse beams +
Subs laying in wait
get them when passing
through beam -
2 Cases + perhaps there
are lots more not
reported

Knierim figs

• submarine - 3400 yards from ship

Ships gives 100% noise & each 10% at Cargo boat then phone would be

- 500 yards
- 1000
- 1500

	Boat 100	Sub 10
500 yds — "	1.96	7.6
1000 — "	.49	5.96
1500 —	.22	4.82

Supposing Sub + phone same distance + Cargo boat makes 100 parts of noise at the boat + Submarine 10 parts at the Submarine - then ~~det~~ with phone at Boat,

Boat 100

noise from sub at Cargo after [illegible]

At Key

From 1915 to date.

Torpedoed-unseen 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 III	33
" Wake seen no Sub 𝍸 𝍸 𝍸 𝍸	20
" afterwards Sub 𝍸 𝍸 I	11
Sub seen then torpedoed 𝍸 𝍸 I	
Sub not seen, then shot at 𝍸 III	8
Sunk at night 𝍸	
Saw wake, Turned not sunk 𝍸 I	6
Sighted Sub before sunk 𝍸 I	

1

83% no Sub seen —

Attacks - not all sunk

Sept

Atlantic 54 attacks
10 nights (5 beg moon)
5 twilight
1 dawn
35 daylight —

Northern 19 —
1 twilight
1 dawn
17 daylight

11% at night

Channel 30 — 8 nights (4 moon)
5 twilight
3 dawn
14 daylight

Med 21 — 11 nights 3 moon
1 dawn
9 daylight

Gibraltar 36 steam 4 nights (3 moon)
4 twilight
28 daylight —

Notebook Series -- Notebooks by Edison
Notebook, N-17-00-00.4

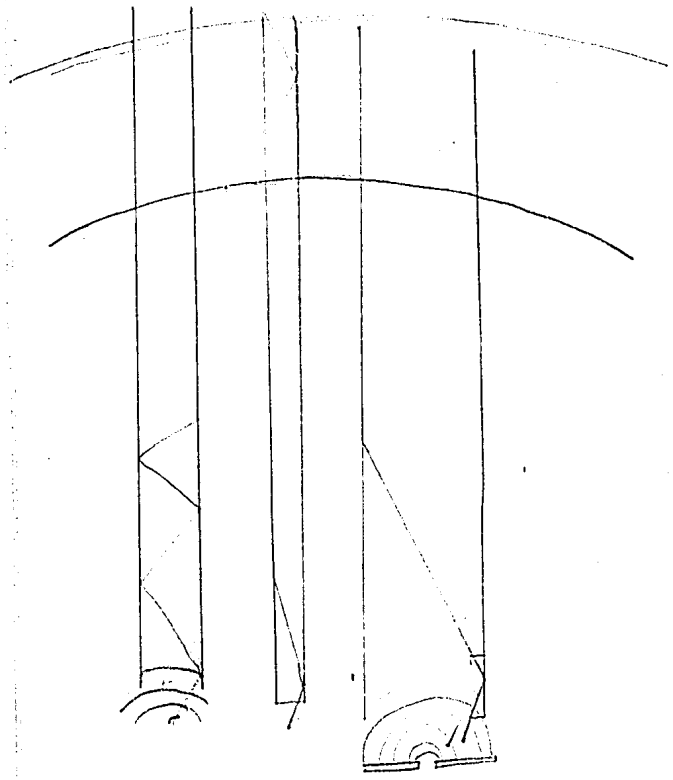
This undated notebook was used by Edison, probably during 1917. The entries pertain to a variety of subjects. Some of the notes relate to chemical products, byproducts, and reactions. One entry is entitled "Anilin"; another, "Carbolic Acid (Shale Salt)." In addition, there are speculative notes regarding submarine warfare. These suggest methods of observing and disabling the periscopes of the enemy, deflecting torpedoes, and detecting the sounds of enemy submarines underwater. On the last page are speculations involving the role of the "ether." Some of the notes were taken from published sources, including *King's American Dispensatory*. The cover is marked "Aniline Phenol War." The pages are unnumbered. Approximately 30 pages have been used.

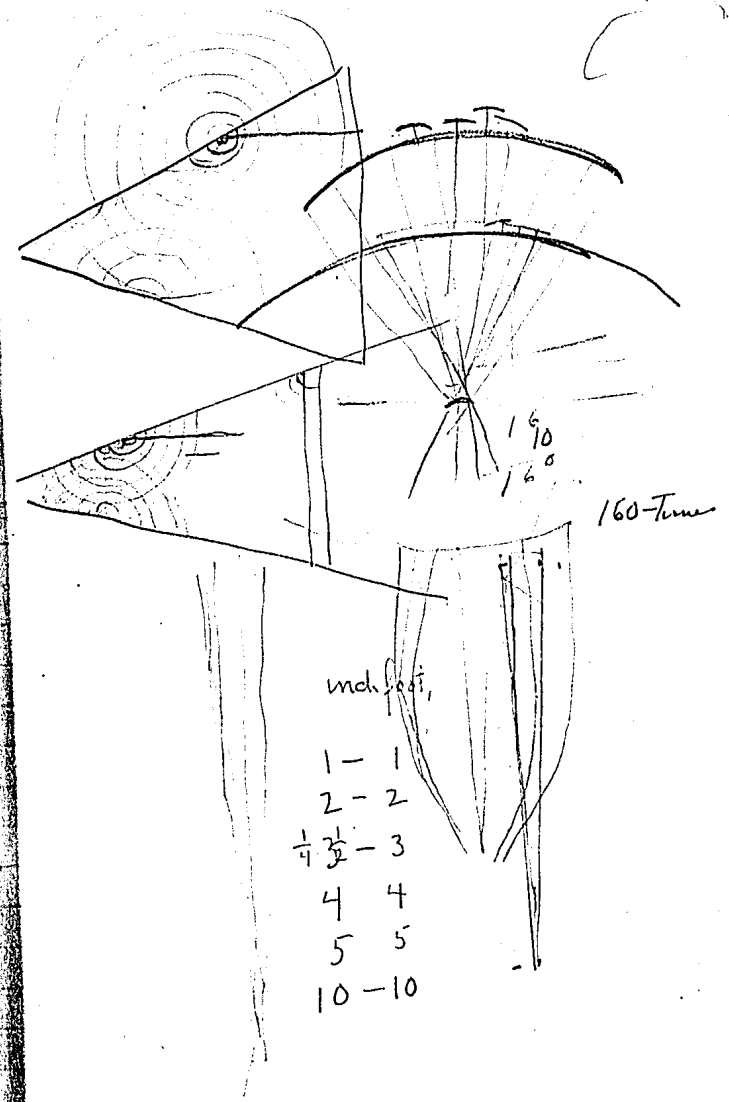
Anilin

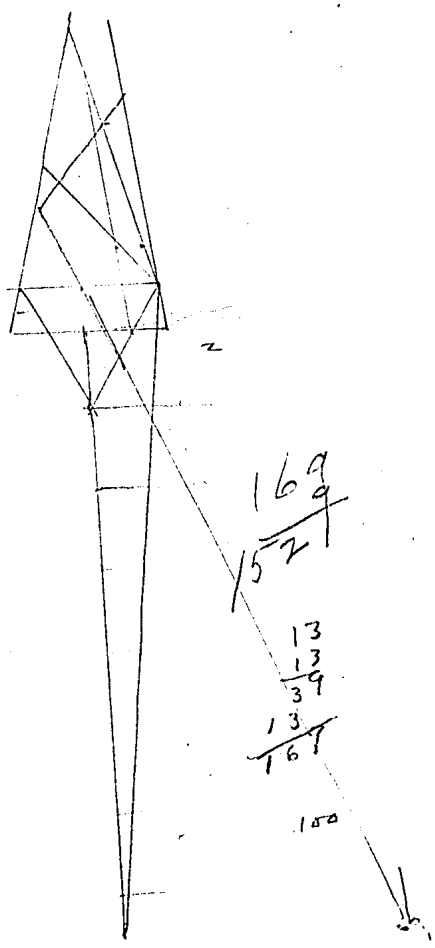
Amount of iron in waste acid from mixture steel nitrating pots which produces 1500 lbs per run.

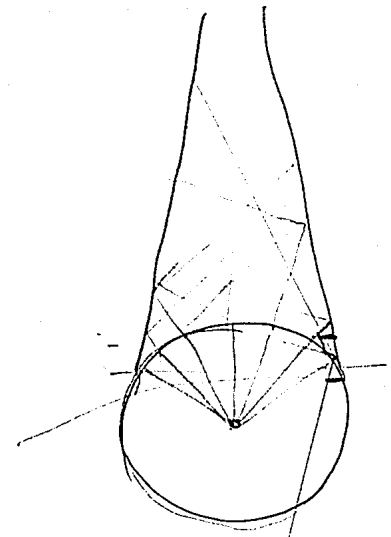
One gallon contains 2.67 grams
250 gals of charge contains 667 grms metallic iron.

Waste acids put in gallon bottle, required 4 days to settle the white sediment so its depth at bottom was 1/2 inch.

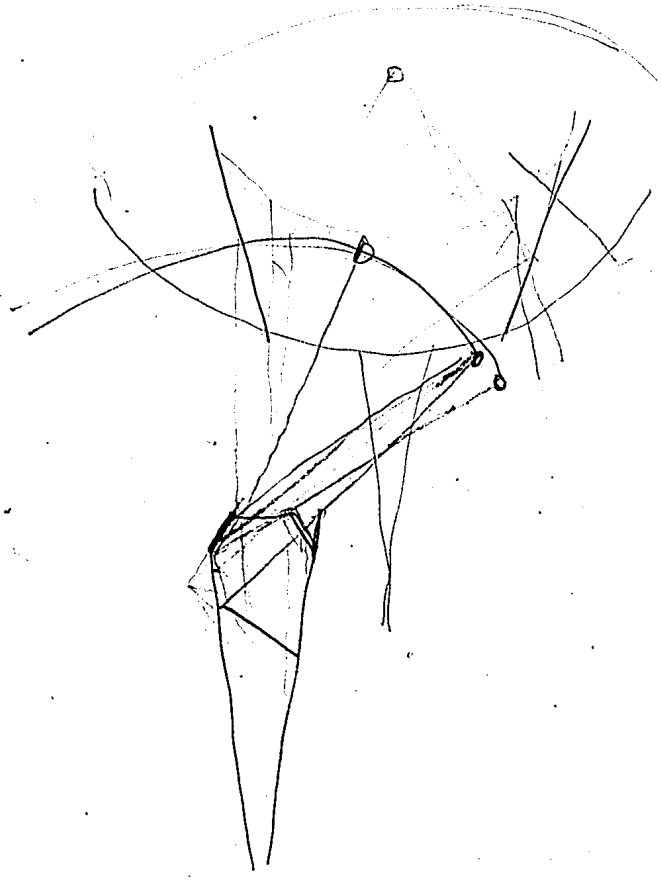


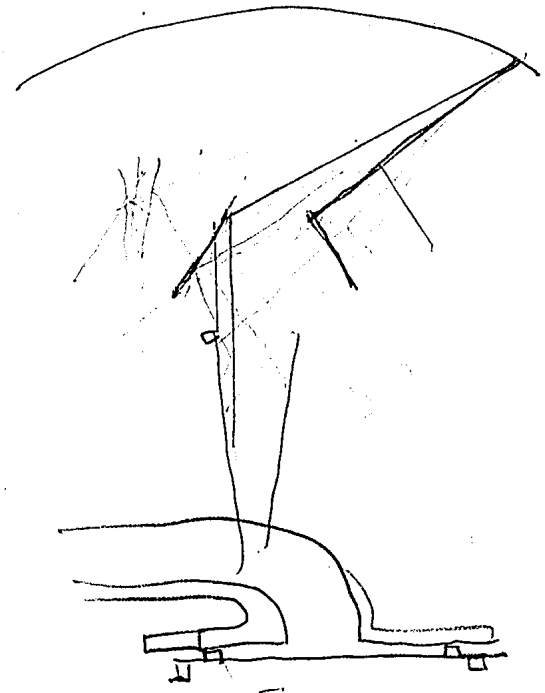

160-Turns
inch feet,
1 - 1
2 - 2
$\frac{1}{4}$ $\frac{1}{2}$ - 3
4 4
5 5
10 - 10





It looks as if 1/4 end of 10 or 12 inch face of ~~12 to 13~~ 10 ft long at 15 ft from source of waves would be clear — The loss by receeding at square of distance 169 whereas Multiplication 1/4 to 10" face is 1600 assuming Multiplication perfect, could run





Rubber Rubber
Ingtion

Notes

Dry plates are more sensitive the higher the temperature —

Cyanin Blue is a dye rapidly bleaches in yellow light

Cyanin — Dicyanin,

Mixtures of Malachite green & Naphthalene blue sensitizes the red

Cerulin S sensitizes Red

Cyanin plates if kept long fog

Alizarin blue S. for infra

see Abney page 471

Panachrome

A large wave compared of sound waves 150 000 per second of frequency 60 ~ formed on a mirror lamp blackened should deflect it as the condensation would push + there would be no rarefaction.

The sound be secondary

The greater the ~~[illegible]~~ light effect the more effect on the light source but actually all light sources in ordinary low light effect their radiation lying chiefly in the Infra Red

Paper soaked in a solution of
1 gram of Paraphenylenediamin
in 5 cc of dilute Nitric acid
(2 cc acid SG 1.2 to 3 cc Water)
dried rapidly in Bunsen flame
paper becomes blue on exposure
to Ultra Violet light
(rays from ordinary filaments
do not affect it)

Heraeus Quartz Hg
Lamp (fused) most powerful
of all for Ultra Vio

Cadmium Electrodes in
Spark gap next best

Look out rays don't
Strike Eye or Skin

Water which is transparent to the Visible rays up to 200 μμ has a strong absorption for the long waves of the Infra red

Only light that is absorbed in a certain substance is active in producing Chemical Change

Signal by key & absorbing solution put on & off a light & observe with a spectroscope then glass & light - so not to change the light

In absorption, the more complicated the molecule the more the absorption shifts towards the red

Anthracene is converted by light into Dianthracene

solution becomes colorless

in the dark the Dianthracene reverts spontaneously to anthracene in fact light polymerizes anthracene or darkens late it depolymerizes

Could possibly make an instrument based on this

All selectively absorbing bodies are light sensitive

Adsorption

Adsorption theory of color / Vio

selenium better

Aromatic Fulgides

for instance Triphenyl fulgide

powders from Orange-red or yellow
Crystals to dark brown in place
of sunlight & are recoverable
yellow in dark - heat enormously
assists in returning

Uranium Salts Exceedingly
Sensitive to light

Tungsten Sensitive

Chromium salts photo Sensitive

Molybdenum salts

T2 - nearly all form
light sensitive - up to long
heat rays -

S2 - sensitive to heat rays + light

S sensitive to radiant heat

Luminosity of Certain Phosphors are diminished & even quenched by infra red

Cl & Br if got free of O is Extraordinarily Sensitive to light, Higher the purification to get rid of Ox the more sensitive, Shepland Photo Chem 290

Mercuric Chl & ammonium Oxalate in Sol, the Hg is reduced to Mercurous Chloride - addition of Cl increases the sensitiveness also from

Light accumulation
Calorie Lemon Radiation

Chlorine or Carbon Monoxide
forms Phosgene by Light

Mixed gas in enclosed space
with Diaphanogen or Mirror
light changes the pressure

Marked Effect of Halogens
on aromatic Compounds with
side chains by light
if weak light used one compound
formed bright light another no
light connection.
The whole series of
alkyl-benzene hydrocarbons
act thus.

Radiant heat may increase or decrease function of a retaining surface & we can get a definite theory

Double Iodides of Mercury & Alkali very sensitive to radiant heat which can be used to map out lines

Isomeria Keto Enolens of high Molecular weight

Piperonylidine Acetone
Ortho or para Benzylidene
di-oxy p benzoins
see Ann Chem 1910
374 - 237 - Slabbert & Wacker

The bleaching out of dyes by light depends upon the other ingredients for instance fluorescein dont bleach out to a leuco body in presence of H_2O_2 but did in a mixt of KOH & NH_4OH.

Extensive investigation on light bleaching of Dyes by Ebbinghaus

Über die Einwirkung des Lichtes auf ~~Farben~~ Farben

also - Ozazones & hydrazones for instance Benzaldehyde phenyl hydrazone

Light changes a gas & makes it combust — use Mercury gas - Mabogh on Celluloid ~~use~~

Photo plate illuminated with phosphorescent light weak & distant objects photographed by infra red image on plate Quenching Effect of phosphorescent light - see Stephens 404-5 for exact number of phosphors see Wied Annalen 1889 38 90

unbleaching by light
(Dyes) O_2 is used up
+ fixed
water or water vapor
favorable reaction
impurities, particularly
Certain Electrolytes
influence the process

Quinone reduced by
light to Quinhydrone
+ ultimately to dihydroxybenzene

Submarines – Drag bags all ships
Oil with lampblack – gives dull
Coating periscopes of hostile
Submarines – Ordinary Palmanni paint for
night work

Detecting submarines Ferrenden
Oscillator with angle downward
detector for direction – + Echo –
Think special sound waves
necessary accumulative reception
apparatus — with 2
least Cum triangulate —
get direction also of
moving –

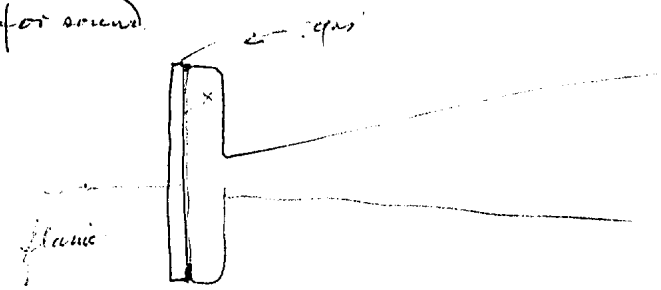
Observers in closed smallchamber
on deck – must head 2 men
all light but narrow ranges
Cut off from Eyes – sweep
around the horizon with the
Narrow View Chamber black
men relieve each other every
few minutes – perhaps
Bellerdown.

find out how deep the torpedo goes below surface when shot at a steamer. Seems as if it could be hit with a large bullet Maxim gun I mean steel bullet if not much below surface especially if set Must need -

If wooden vessels are respected by metals, it would seem with proper vessels a application ~~very~~ different from any now used presence of so large a surface of metal as a ship should give echo several miles away

How sensitive is a selenium cell in Vacuo The current of which is varied to be intermitted so make audible sounds in a telephone -
+ Reflector Condensing light waves on the cell - It is probable it includes sensitive thermo or bolometer or thermopile -

I wonder how sensitive a cell would be for sound



also flame might play over the surface of graphitized lock oil stone to vary its Resistance,

If Acetylene gas used Coated photo

If wireless receiver ~~was~~ trace a diagram of metal onto fresh tile Connect the collector to antenna

I think there is a good field for something new for light or other waves depending the friction of a film on a glass disc over which passes a friction Watch pen & Dictaphone to make it audible

Carbolic Acid (Phalt Salt)

Single Na in Benzinesulfonate Soda

58.5 NaCl turns 158 lbs Benzinesulfonic Acid into the Soda Salt. ?

Kings proportions
480 Gals water
1080 pounds salt
260 gals sulfonated Liquor

Sulphonation

275 gallons Benzol.
30 gals 98% H_2SO_4
213 gals 20% Oleum

King says -

If 200 gals of Sulphonated Liquor is used then not less than 400 gals of water containing 900 lbs NaCl should be used

He suggests 500 Gals water + 1150 lbs Salt be used at first + if found OK then 400 gals water + 900 lbs salt.

He says he does not think it possible to go below this limit

They always used 2 Volumes of Salting Liquor to 1 Volume of Sulfonated Liquor

---

100 gals water saturated with NaCl increases in bulk 9.15%

3600 / 62.50 = 600 / 20 = 30 / 2.16 = 2.5 / 2

Benzenesulfonate Soda
87% acid
12.7 Na –

Pure Benzenesulfonate Soda contains
62.5% of Phenol.

Exposed to air + Centrifuge liquor
for 3 days

Copper	1" sqr	lost	609 milgrams
Nickel	"	65	"
Brass	"	90	"

The pieces were 1/32 thick Exposing
2 sqr inches of surface —

Navy

There must be a very noticeable difference between a submarine propeller working deep in water & one on or near the surface with proper appreciation this could be detected 2 or 3 miles away & the direction found

Also the jar of the whole cigar shaped body will give waves of high frequency compared to the screw. It seems to me this is a tremendous something to go on

It would perhaps be necessary to break up the waves of the propeller or screw into highly audible waves by a revolving shutter,

Possibly an accumulating device could be introduced ~~for~~

We should make an very sensitive recording phone 500 to 800 grooves to the inch - tracked light on light speaker ~~[illegible]~~

After removing alcohol & other solvents all that will come out from Oxygen respirator the remainder will be of uniform as the Bitumen most sensitive to light = Probably that this alteration by light would change the friction & afford a reproduction by friction reproducer & Diaphram & Sound recorded on way to reproduce original picture

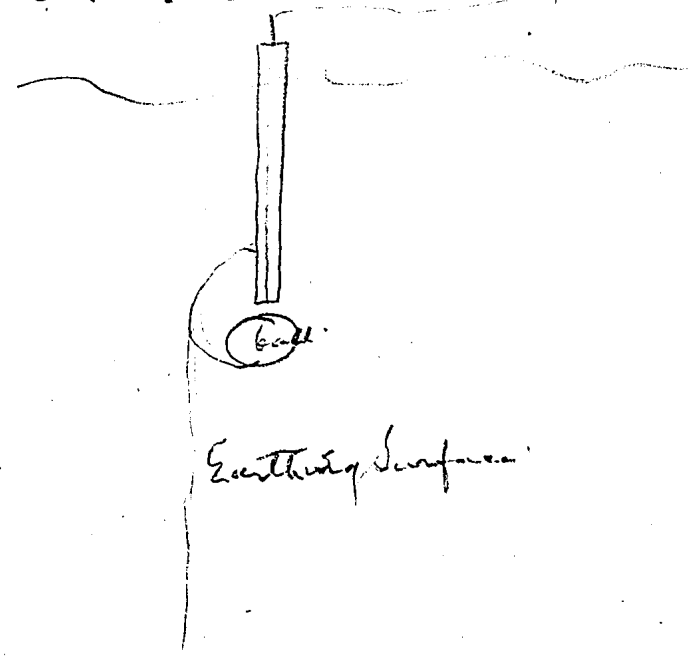
25000 | 4,500,000
25000

Same with Italian

A fast Motor boat with shield
the whole K forward from ship
One on each side could be
sent out to intercept the
Torpedo —

A strip of the Sea 50 miles
wide 100 miles long with
an oil film (black) $\frac{1}{40}$ of 1000 thick
requires
1450 gals to Mile — 5000 Sq. Miles
2,250,000 gals
50000 66's, 3" $150,000
This amt, much of my figures
are OK — If Aluminum paint
necessary weight cost
$8000 to $150,000 more

Think sound waves with Excessively sharp fronts in water can be made by condenser discharges 80 to second or more using armored electrodes -



It is possible that the undulations of the form of sound waves might partly go in the Ether as well as by air or disturbances of Atmospheric pressure or detectable by some kind of apparatus?

5240
50
26200
50

262 000 - feet wide -

524 000 long

5700 -
8
45.600
1000 bbls -
25

524000
262
104500
44000
31400
104800
137

137 million feet

24000 to 1 cubic ft

24000) 137 000 000 (5708
120 000
17000000
16800000
200000

5240
5240
20960
2480
26200
27480

27 000 000

12000
40
480000

480 000 to a foot -

480 000) 27 000 000 (56
24 000 000
3 000 000
2 880 000
8
48

Notebook Series -- Notebooks by Edison
Notebook, N-18-05-23

This notebook was used by Edison in May 1918. The one entry is entitled "New Disc Expts" and consists of notes on experimental mixtures of china clay, cotton flock, rosin, and other materials. Included are comments on the hardness of each mixture and, in two cases, indications that a particular mixture seemed "promising" for cylinder or disc record blanks. The pages are unnumbered. Only 6 pages have been used.

280) 800 (2.9
560
2400
242

2½ cents

45 lbs Resin

75430

Acme Co.,

MFG. STATIONERS,
96 JOHN ST.
AND
19 PLATT ST.
NEW YORK.

112
40
50
202

5 flock

5 clean

160 lbs.

Cant see any flock –

New Disc Experts
May 23rd 1918

Hard Coal tar pitch
60 pitch –
60 China Clay
3 Cotton if flock,
quite hard to scratch
works fairly well in
small 2 ½" discs
sometimes dont fill perfect
Promising for straight
record anyway for Cylinders
and perhaps Varnish
for disc
Tried 60 Pitch 67 China Clay 3 flock
only good fill good, wants more
flock
Cuts very hard
but not so hard as shellac

Phenolrosin 50 China
Clay 50 Extraordinarily
strong, think well
stand Diamond
it will varnish also
probably — too
Expensive —

Write off B.S.
also Wood Pitch -
test.

36 Rosin 4 flock 60
China Clay Very hard
Can scarcely cut with
Knife will stand Drawing
OK but its too dry.
Must have more Rosin
to make it flow &
handle — its strong
will stand more
flock which Cant
be seen
VERY PROMISING

Notebook Series -- Notebooks by Edison
Notebook, N-18-07-01

This undated notebook was used by Edison in July 1918. It contains entries on the preparation of metallic and other compounds for use in the chalk telephone. Several of the early entries are crossed out and noted as "Entrd." Some of these were entered into N-18-07-18.2. The front cover is labeled "Chalk Telephone {Rough Notes}." The pages are unnumbered. Only 14 pages have been used.

19992

Home Co.

MFG. STATIONERS,
96 JOHN ST.
AND
19 PLATT ST.
NEW YORK.

Chalk Telephone

Rough Notes.

ZINC OXALATE 500 atm.

5.4 + 0.5 (2) 5/16

for 13/32 7.0 + 0.6 (2) 7/16

6.5 + 0.6 (2) 13/32 (-) O.K.

Entered

Copper Oxide 500 atm.

12 + 0.8 (2) 33/64"

9.5 + 0.7 (2) O.K.

Ent

Copper Carbonate 500 atm.

9.5 + 0.7 (2) 39/64"

6.4 + 0.5 (2)

6.5 + 0.5 (2) O.K.

Ent

Cobalt Sulphate 500 atm.

14.0 + 0.5 (2) Total wt. 14.5 gms.

for 1 - wt total 6.1 Length

5.2 gms total O.K.

5.1 + 0.2 (2) not.

Entered

Manganese Acetate 500

5.4 + 0.4 (2) 37/64" 6.0 total strike to cylinder

3.8 + 0.3 (2)

9.7

Entrd

9.0 + 0.7 (2)

4.3 of above little long 24

4.2 " "

Manganese Black Oxide 500

8.4 + 0.5 (2) 31/64 8.85 total

7.05 + 0.5 (2)

Entrd

15 + 1.0 (2) 16

7.4 (total) of above

7.6

Tin Oxide, Black (Stannous) 500

~~7.9 + 0.5 (2) 11/32~~

Entrd

~~9.4 + 0.6 (10)~~

~~9.8 + 0.6 (10)~~

~~9.7 + 0.6 (10)~~ OK

Nickel-Ammonium Sulphate 500

~~5.5 + 0.4 (2) 31/64 100 wet.~~

4.7 + 0.3 (10)

Entrd

Bismuth Oxychlorate 500

~~10 + 0.7 (2) 21/64~~

12.3 + 0.9 (2) OK ✓

Entrd.

Bismuth Subcarbonate 500

~~12.2 + 0.8 (2)~~

12.1 + 0.8 (2)

Entrd

Lead Sulphate 500

~~12.1 + 0.8 (2) 100 wet 25/64~~

~~12.6 + 0.4 (2)~~

~~12.6 + 0.6 (10)~~

12.6 0.8 (10)

Entrd

Lead Nitrate C.P. 500

27.5 + 0.6 (10) Total 28.2

~~Total 13.1 (total) of above~~ $\frac{15}{32}$ Entd

11.5 of above

Lead Phosphate 500

~~30 + 1.2 (10) 31.3 total~~ Entd

~~12 of above~~ $\frac{7}{16}$

11.3 " "

Lead Peroxide 500 Entd

~~12 + 0.7 (2)~~ $\frac{21}{64}$

14.9 + 0.8 (2) O.K. 15.55 (total)

Lead Oxide (Yellow) PbO 500

15.0 + 0.8 (2) Too wet. $\frac{5}{16}$ Entd

19.5 + 0.6 (2) 7/16"

18.5 + 0.6 (10)

Calcium Ferrocyanide Entrd

4.4 + 0.4 (2) 500 O.K.

Mercury Oxide Red 500

14.8 + 0.5 (2) 11/32 Entrd

17.5 + 0.6 (2)

Colloidal Ferric Hydroxide 500 Entrd

6.5

Lithium Carbonate 500 Entrd

4.0 + 0.6 (10) Breaks when machined (drilled)

4.0 + 0.8 (10)

Aluminum Oxyde.

5 + 0.8 (10)

5 + 1.2 (10)

5 + 2.0 (10)

Iron Citrate
4.6 + 0.4 (10) 500 cracks when drying

Anthracene (pure)
4.3 $\frac{33}{64}$

(3.4)

P. Amido Phenol
3.5 $\frac{31}{64}$

3.0 $\frac{7}{16}$

(2.9)

P. Amido Phenol Hydrochloride
3.0 $\frac{3}{8}$

3.3
(3.2)

Para Phenylene Diamine
Recrystal from Benzol M.P. 140°C.

3.3 $\frac{15}{3.2}$ 2.9

Benzidine

3.0 $\frac{23}{64}$

3.4

Benzidine Sulphate

3.4 $\frac{29}{64}$

3.1

3.2

Naphthalene

4.5 ~~3.2~~ $\frac{37}{64}$

~~2.7~~

3.2

Iron Citrate

4.6 + 0.4 (10) - 500 cracks while drying

4.6 + 0 - 500 $\frac{15}{32}$

~~4.5 + 0.2 (2) - 500~~

4.5 + 0.2 (2) - 500 $\frac{13}{32}$

16 + 0.4 (2) ~~[illegible]~~

total weight = 16.4

4.1 500

4 + 0.1

750 atm

Copper Oxide

9.7 + 0.6 cc 20% KOH - 750 atm

Strontium Oxalate

4.5 gms 750 atm

Calcium Silicate

2.8 gms 750 atm.

Calcium Oxalate

3.3 gms 750 atm

1000 atm

Calcium Silicate
Calcium Oxalate
Strontium Oxalate

on 1600# gage
349 #/□"

Calcium Silicate

3.1 gms 1000 atm

29"/64

2.8 gms

3.1
26
186
62
29) 806 (27
58
226
203
23

Calcium Oxalate

3.5 gms 7/16

3.3 gms

3.5
13
105
35
14) 455 (3.25
42
35
28
70

Strontium Oxalate

4.5 gms

Strontium Carbonate - 500 atm

6.4 gms + 0.3 cc. 2% KOH length OK

total wt 6.78 gms. - sticks

for 2 ~~12.8 gms + 0.4 cc 2% KOH~~

13.0 gms + 0.4 cc 2% KOH

6.2 gms of above for 1 OK.

13.0 gms + 0.7 cc. 2% KOH soln. total wt 13.7

6.7 gms of above for 1 length. $\frac{27}{64}$ "

$$\begin{array}{r} 6.7 \\ 26 \\ \hline 402 \\ 134 \\ \hline 27\,\overline{)\,174.2} \\ 162 \\ \hline 122 \\ 108 \\ \hline 140 \\ 135 \\ \hline 5 \end{array} \quad 6.45$$

6.5 gms of above

$\frac{6.5}{13.7} \times 13$

$$\begin{array}{r} 6.5 \\ 13 \\ \hline 195 \\ 65 \\ \hline 13.7\,\overline{)\,84.5} \\ 82.2 \\ \hline 230 \end{array} \quad 6.2$$

for 1 6.2 gms + 0.3 cc 2% KOH soln.

13.0 gms + 0.8 cc. 2% KOH soln.

total wt. 13.8 gms.

6.6 gms of above for 1 length

$\frac{6.6}{13.8} \times 13$

$$\begin{array}{r} 6.6 \\ 13 \\ \hline 198 \\ 66 \\ \hline 85.8 \end{array}$$

$$\begin{array}{r} 13.8\,\overline{)\,85.8} \quad 6.22 \\ 828 \\ \hline 300 \\ 276 \\ \hline 240 \end{array} \quad 12.44$$

STRONTIUM CARBONATE 750 atm

for 2 — 15 gms + 0.6 cc. 20% KOH Solu.

for 1 — 6.9 of above. length 13/32"

total weight = 15.6 gms

For 1:-

$\frac{6.9}{15.6} \times 15$

$$\begin{array}{r} 6.9 \\ 15 \\ \hline 345 \\ 69 \\ \hline 15.6\overline{)103.5}\ \ 6.63^{(+)} \text{ gms Str. Carb.} \\ 936 \\ \hline 990 \\ 936 \\ \hline 540 \\ 468 \\ \hline 720 \end{array}$$

$\frac{6.9}{15.6} \times 0.6$

$$\begin{array}{r} 15.6\overline{)41.4}\ \ 2.654^{(-)} \\ 312 \\ \hline 1020 \\ 936 \\ \hline 840 \\ 780 \\ \hline 60 \end{array}$$

$$\begin{array}{r} 6.634 \\ .265 \\ \hline 6.899 \\ \hline 6.9 \end{array}$$

For 2 without waste $2 \times 6.64 =$ 13.28 gms powder

plus $2 \times .265 =$ .530 cc. 20% KOH Solu.

for 1, use 6.9 gms of above.

STRONTIUM CARBONATE 1000 atm.
349#/□" on 1000# gauge

Mix.
for 2 15 + 0.6 cc. 2% KOH soln.
7.3 of above: length 13/32 O.K.
∴ 1 of above contains
7 gms Stront. Carb.
0.3 cc. 2% KOH soln.

Total wt 15.6

$\frac{7.3}{15.6} \times 15$ 7 gms.

$\frac{7.3}{15.6} \times 0.6$ Say 0.3

7.3
15
365
73
15.6) 109.5 (7.02
1092
300

15.6) 4.38 (2
312
6

for 2 14 gms + 0.6 cc. 2%

Colloidal Chromic Hydroxide 500 atm

200 mesh

4.9 gms length $\frac{7}{16}$"

4.9
13
14.7
49
14) 63.7 (4.55
56
77
70
70

4.6 grams — length

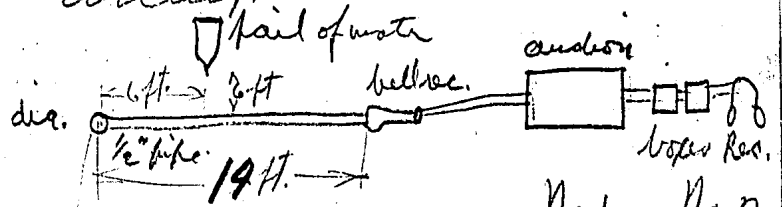
Notebook Series -- Notebooks by Edison
Notebook, N-18-07-02

This notebook was used during July 1918. Most of the entries are by Edison, but there are also some by John A. Hanley. Many of these notes were made in the garage at Glenmont, Edison's home in Llewellyn Park, New Jersey, where he was working with Hanley, William A. Hayes, and probably James M. Burns on a series of experiments pertaining to the measurement and detection of sound under water in connection with work for the U.S. Navy during World War I. Included are tests with various devices used to pick up and amplify the sound of dripping or flowing water, possibly as a way of compensating for the interference experienced in listening to a sound detection device as it was towed behind a moving vessel. Among the components employed are long brass and rubber tubes, telephone receivers, and audions. The experiments are continued in N-18-07-11. The front cover is marked "No 1" and "Moore" and is labeled "War." The pages are unnumbered. Approximately 120 pages have been used.

MFG. STATIONERS,
66 JOHN ST.
AND
15 PIATT ST.
NEW YORK.

Book 1 July 2/18.

Test No 1.
Dropped water from height of 6 ft (calculated velocity 10 knots per hour) 6 ft from diaphram, on ½" brass tubing.
Listening through 3 stage audion.
Lines were taped in circuit.



	No 1.	No 2.
Hayes lost at	63	69
Hanley " "	70	70
Burke " "	54	60

Reversed Telephone on 2nd

1/32 walls ½" inside diam

Test
No 2. Increased length of ½" brass pipe from 14 ft to 28 ft.

	No 1.	No 2.
Hayes head over	71	71
Hanley " "	71	71
Burns " "	71	71

Test No 3.

Dropped water on piece of tin at angle of 45°, 4 ft. from diaphram.
28 ft tubing same as test No 2.

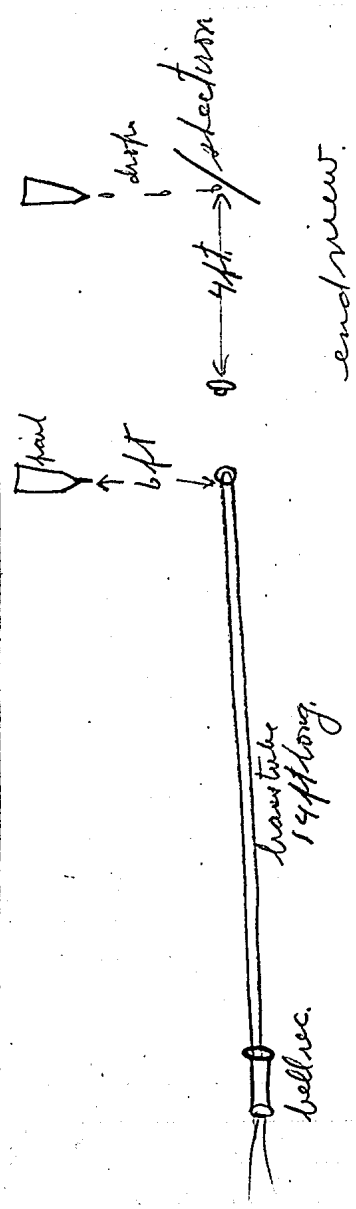
Hayes	40
Hanley	42
Burns.	36

Test No 4.
Same as No 3 except 14 ft. length of tubing instead of 28 ft.

Hayes	42
Hanley	42
Burns.	38

Cat No 5.
Removed mica diaphram from tube and plugged up hole with cork.

Hayes 6
Henley. 4
Burns. nil



Like this.

July 3. 18.

Comparative readings of 3 and 4 stage audions

No 1. 14 ft brass tubing with mica diaphram.
Water dropping at a height of 6 ft. on sheet iron at 45° angle. 4 ft away from diaphram.

3 stage

Hayes	42
Hanley	42
Burns.	

4 stage

Hayes	64
Hanley	67
Burns.	

Note something apparently wrong with 4th stage in audion.

3 stage

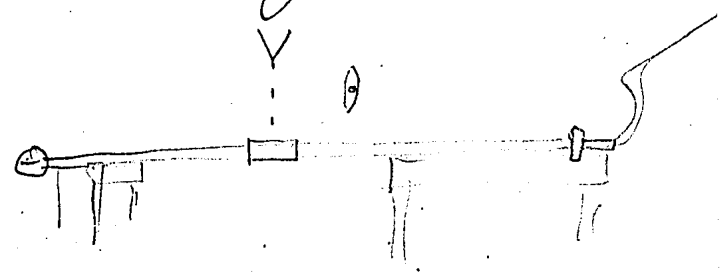
No 2,

Water dropping on stream line form tin covered with rubber,

stuffed with cow hair around glass tube.

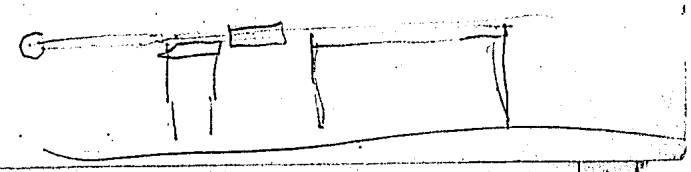
drops is 6 ft. away from diaphram.

~~Hanley~~	~~48~~
Hanley.	46



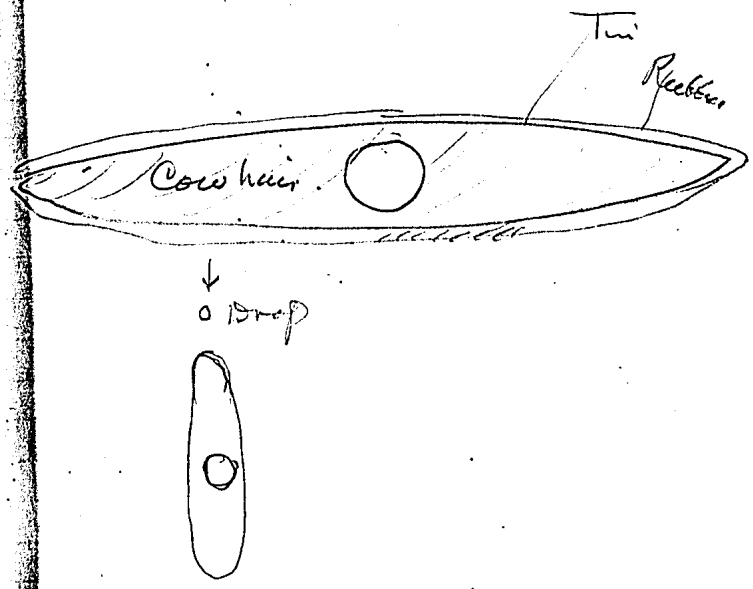
Support too far. Thick drop sliding caused rod vibrate & made sound

put it nearer



3 Stage
Thermakes it louder

Hayes 61 on book
Hanley 61



We now take off diaphram
plug tube with a Cork

3 stage

Thinking the drop jaw tube &
this starts diaphgm.

Hayes 46-
Hanly 52

Shows some of sound Came from
Diaphm -

We now drop water right on
brass tube while plugged

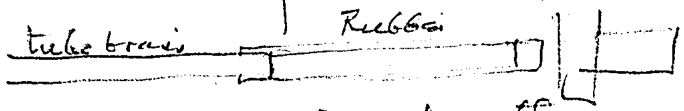
Hayes 60-
Hanly 58

Possibly the sound is
Conducted to phone Item

3 stage Induction

the metallic pipe not through air at all —

We now put in of rubber tubing 4 ft long



pipe is plugged at other end

Hayes 38
Hanley 48

We now shorten the Rubber tube to 6 inches as too large as loss by friction with 4 ft. of rubber tubing connecting to phone

Hayes 54
Hanly 58

3 Stage

Now with the 6" rubber tubing connecting phone to pipe we drop the water on the rubber to determine how much less is the sound than dropping water direct on the brass pipe (Tube end plugged)

Hayes 38

Hanley 38

3 Stange -

Stange we got it too strong through the rubber & through Cow hair to brass tube - We now let it drop into pan + not touching pipe this makes considerable sound + we may hear it in tube with the phone at one end

Hayes Nothing
Hanly Nothing

3 Stage

We now know the drop distinct to tube by Conduction throw rubber, tin + Cow hair to tube + that acts as a diaphragm of some kind

We now take out Cow hair + pack it in very loose as it was packed tight before

Hayes — 28

Hanley 26 -

Dropping on tube

3 stage –

The chaos sound was
Conducted through the
Cow hair as a mass –
not through air interstices

We have been dropping
the water on Edge of
others

We now drop it on middle
with same conditions of
last Experiment, loose Cow hair

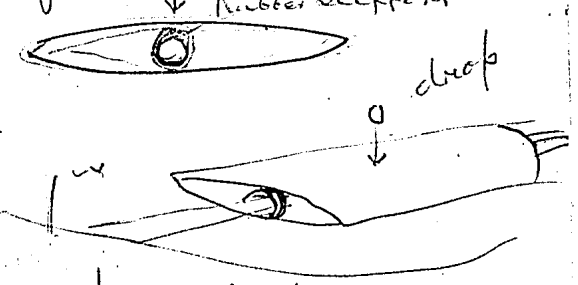
Hayes 38.
Hanly 38.

~~By mistake this was dropped on Edge~~

3 Stage

We now take out cocohair + support tube by rubber at each end of ⬭ only contact from tube to boat is through the 2 rubber supports at each end of boat;

We continue to drop on wide part of boat (drop)



Hayes | 28
Hanley 24-

3 slaïque

We now drop the Experiment on last page & drop it on float of Coat,

Hayes	46.
Hanley	48

Evidently rubber at both Ends not so good as Lace Cowhair

Note =

Wool is better than Cowhair
it more Elastic + finer
if we get the right kind
+ prevents it shape a
donut pack —

Rubber Sponge might
answer,

3 Plaque -

Dropping on Edge —

We take out a rid rubber
Dumpoils at each end
of Coat + hold by
Elastics of rubber
Hayes 4 ? ?
Hanly 2

There are 2 Elastic bands
on each side holding it
up -

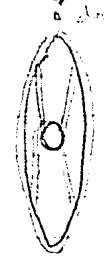
This is fine result but

Note, Apparently the 1/32 walls of our tube is acting as a diaphragm — We may have to use 1/16 or even 1/8 walls.

3rd Class

The Elastics are too small to practically keep pipe central in practice, only ordinary 1/16 thin Elastics.

We now use 3/16 only thin wall 1/32 wall rubber tubing for suspension

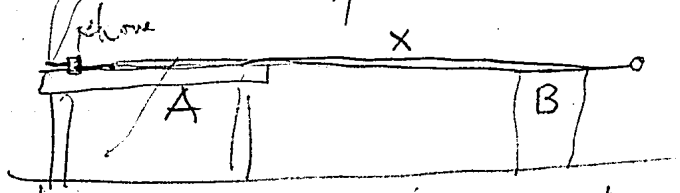


Hayes 6
Hanley 4

July 5 1918 –
3 Stage,

We are now on the Concrete garage at the house, using small room next to large one for Audion & listening – Bagdad says it is very quiet even ignore quiet that of Otto room at Kaa nights, as mr Tom & Trolley bother there,

Expt A



Band on Cow horn Z.[illegible] Knock out A + B – Diaphm end of Tube plugged – Water drop falls 6 ft on Tube at X

Hayes 43
Hanley 37

Rubber tube not used in commonly phone to Tube

3 stage July 5 1918

Expt B

We have Connected phone to tube then 6" of Rubber Tubing -

Hayes
Hawley
New Boy ng -

above 60

BWD

The reason we get such high results is due to being very quiet in garage -

We now put a bench under tube where the water drops rolling on soft Rubber this tends to prevent drop from bending tube

3 stage —

We disconnected phone before supporting it on rubber where drop falls + put in ear tubes —
The sound was much louder direct than thru phone + audion.
Showing that direct listening is much more sensitive than phones + audion
It should be used where it is possible as to simplicity itself —
The only way an audion could be

it would be to use a Microphone instead of a Bell phone to receive the sound then a tube to amplify thus by an audion. This would undoubtedly beat direct listening & micro need not be the sensitive one to try

---

Expt C

We now try support of tube on rubber, & have water nuts –

No difference

Expt D

We take out support & put in a plugged tube with walls $\frac{1}{16}$ thick, at same time the water drop falls 3 ft instead of 6 ft as 6 ft gives over 60 on boxes –

Hayes
Hanley – Hear 60 –

July 5/1918

Expt E

Same conditions as D but water drops 2 ft

1/16 wall tube
show 6" [illegible]

Hayes
Hanley - Hear to 60

Expt F We now let water drop 6 inches plugged

Hayes 36
Hanley 38

Expt G

Same as F but $\frac{1}{32}$ wall old pipe substituted

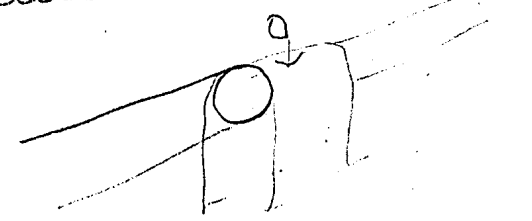
Hayes 44
Hanly 42

Evidently the $\frac{1}{32}$ wall is very little different from the $\frac{1}{16}$ wall, the probability is that walls do not act as diaphragm but simply conduct the wave

So thickness will not be of much advantage to us

Expt H

Same as G but piece sheet rubber



$\frac{1}{32}$ thick laid over pipe upon which water drops the 6" of length —

Hanks : 38

Hanky 40

not much gain here

Expt I.

Same as H, but rubber sheet bent over for drop to strike on Rubber $\frac{1}{4}$" thick

Hayes 42

Hanly 44

Expt J.

Same as I but instead of 1 layer $\frac{1}{4}$" rubber we use $\frac{1}{32}$ rubber sheet a wrap of around 8 times.

Hayes 44

Hanly 42

Strange

We let drop drop in pan
mat on tube tissue of we
can hear it.

Cant hear it on stethoscope

Expt K : tube plugged at dia end

Small $\frac{11}{32}$ wall tube blown on
end then 6" Rubber tubing

Water drops 6 inches
on suspended from
the thin tubing —

Hayes
Hardy

Cant hear
anything

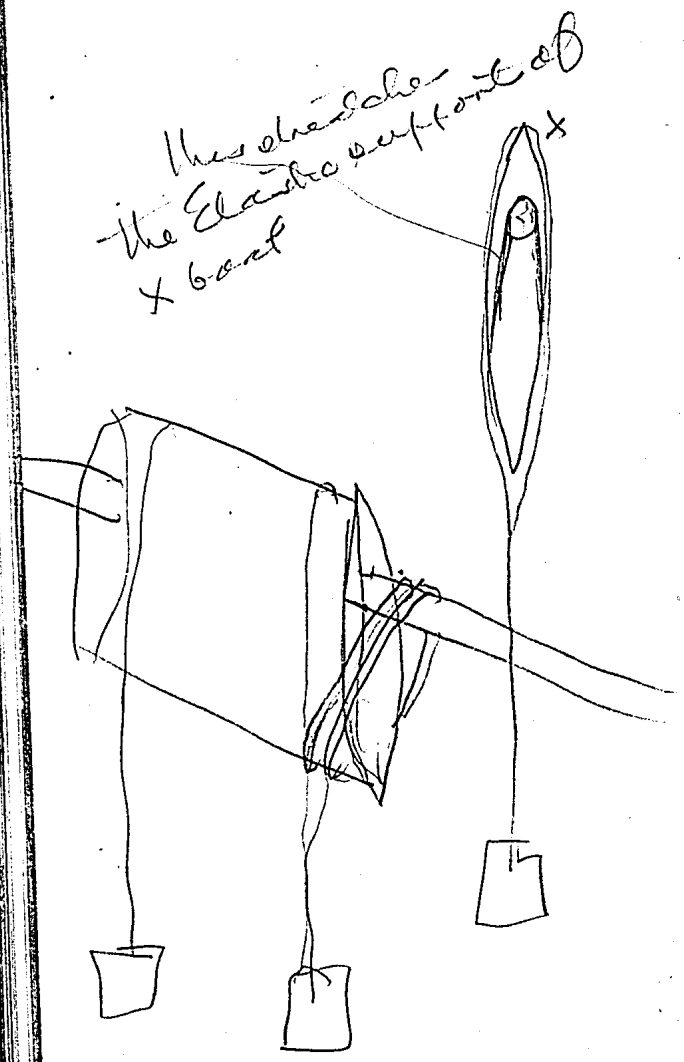
Expt L Same as K but water drops 6 ft instead of 6 inches –

Cant hear anything

Even throwing a Capfull of water on it only slight noise –

Expt M

Used 14 ft Rubber Tube 1/2" inside dia 1/16 wall water at 6 ft Very loud – acts as diaphr –



Expmt N

Same as Expt L

But 2 tubes of 1/4" Rubber holding up boat

Hayes 20

Hanley 12

Shows more rubber conducts sound better -

We use 2 tubes each side + now hang weights over boat to stretch the 2 support tubes at each end — 4 lbs of weight

Hayes 26

Hanley 26 -

Expt O

Same as N but water brought within 4" of boat + turned on full – gives about 1/4" solid stream –

Hayes 6

Hanley 8.

Stream is probably too continuous –

Burns now runs a pencil thru stream to interrupt it

Hayes 20 –

This seems very favorable + shows that a steady pouring of water not intermittent is a very quiet affair but if

$1\frac{1}{4}$ –

310) 1.250 – (400
240

200 –

Sudden or lets collinks its
noisy –

Took piece $\frac{1}{16}$ Soft Rubber
$1\frac{15}{16}$ wide Connected one end
to Scales & other End to a
Clamp clear across, its 1 inch
long.
1 lb pull on Scales elongated rubber to

1 lb	1 3/16 –		.186	64
2	1 1/4		250	62
3	1 5/16		312	
4	1 3/8		375	63
5	1 13/32		416	41
6	1 7/16		434	18
7		1 1/2	500	65
8	1 11/16		682	82
9	1 7/8		875	193

3 Stage -

Expt P

Old $\frac{1}{4}$" $\frac{1}{32}$ wall Tube
Phone at End - 6" rubber
tubing between phone & Tube
at dropping place
surrounded with a piece
of iron gas pipe 20 long
outside dia - $1\frac{11}{16}$
Walls ___ Thick, tube weighs 3 lb

a Diaphram at Each end of
iron pipe with hole for
1/2 pipe used - Outer Edge
rubber tied around iron pipe
by string - This support
iron pipe & 1/4" tube runs
nearly Central Water

All readings on
box Extra high
as compared to
Boat & Lab on
account of quiet
silence & absence
of outside noises

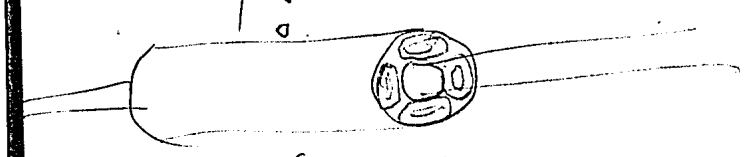
drops 6 feet in drops
on iron pipe — in cellar —
Hayes 56
Hanley 56 —

Dolphin rubber piece of inner
tube & it probably 3/32 —

Expt Q — change position of big pipe till central with pag
Dup of P but 2 lbs
hung weight at each
end, its about all it
will stand as one end
gets badly out of center
Hayes ~~48~~ 50
Hanley 48 —

Expt R Outside tube is now different
Brass 1 of $1\frac{1}{2}$ – inside dia $1\frac{5}{16}$
walls 3/32 – 18" long –

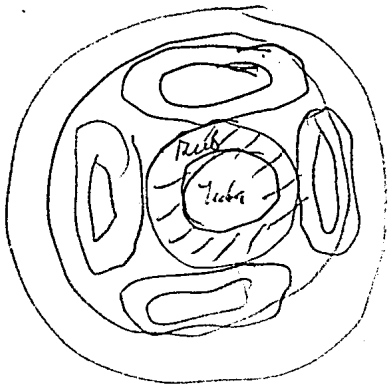
Same as Q but pipe
supported by 4 pieces
1/2 soft rubber tubing
1/2 long at each end



Water 6 ft drop –

Hayes 60 over –
Hardy 60 "

Dup with rubber tubing $\frac{1}{4}$"
long instead of 1/2 – no
well not had weight
of tube –



July 6 1918

We need remove rubber and hold the big tube central by hand not touching small tube,

Hayes
Hanley Nothing -

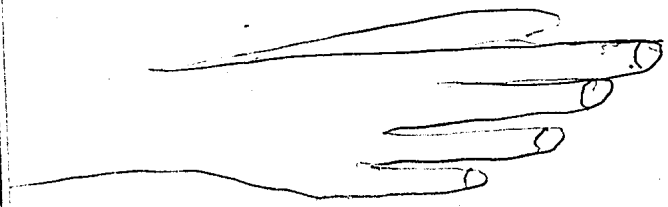
Expt 5

Reg ½ tube plugged, phone on end
Used 6" rubber pipe -

Large brass pipe does ½ pipe.
Ends supported on ½ tubing 3/16 wall
tubing pipe. 6 ft drop —
Length 19 3/4"

Pipe ~~2½~~ mean dia — ~~[illegible]~~
walls 5/32 Weight ~~8 lbs~~

Hayes 36 There is good probably
Hanley 28 due to larger diameter giving more elasticity



Expt T

Dup of S except the rubber tire Cork Hanley got in record

Cant hear anything both Jay

THIS IS FINE

Dup of T

But water drops 6 ft in a Continuous stream of about 1/8 dia strikes tube strongly spattering badly –

Hanley 54
Hayes 54

Continuous fine sound could till much about it until it was stopped & started many times –

Hawley says its not a noise that will interfere with boats

It was only when Burns stopped & stirred water that any noise could be noticed — when water running & one should sat down & listened to audion he would hear nothing but when intermitted then he would be aware of fine continuous roar

Listening direct is a shade louder as Hayes can just detect ring of the metal tube where water strikes, these

waves are too high pitch to get them the hearing individuals of the audion

Expt U - Drop of T

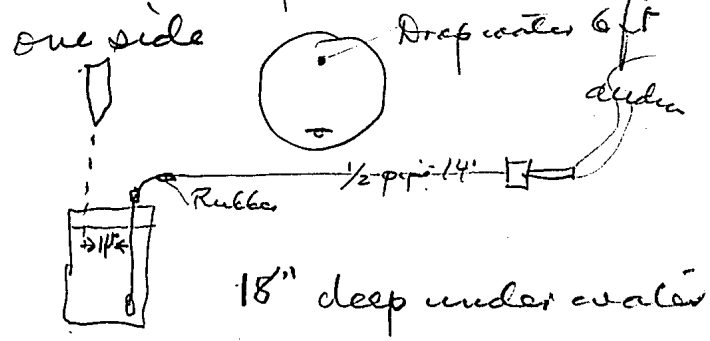
Jack whale decon stacing in Auto room - fitted tube on rubber sponge - dropped a solid column of water from a hose - inside dia of hose 3/4", 6 ft drop inside half of hose 6 foot drop -

Hayes heard 28 on box when column of water moved off 4 on

Hayes says he got a little metallic ring of the big tube He says sound wouldn't bother hearing boats in the least a great sound

Expt V to determine best diaphrm
& if smaller aperture can be
used than full face of diaphrm

We now fill a barrel with
water put on end of 1/2" tube
a Rec water diaphrm & place
it down in the water in bbl
—— inches from bottom to
one side



18" deep under water
6" from bottom, 6 ft drop
Scratched Mica 1 1/2/1000
This we will call No 1
Phone —

be extraordinarily rapid & would responds to high frequencies entirely inaudible to a large amplifier.

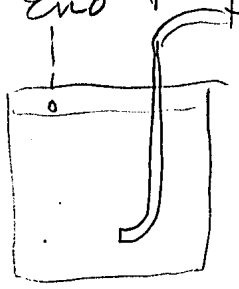
~~We now put plain pipe in No dia 1/4 hole & this plugged to see if any sounds comes outside of the pipe.~~
~~Hayes 18~~
~~Hanley 18.~~

We now put in No 2 Dia which is Rubber sheet rubber - very thin - ~~[illegible]~~ backed up by plate with 1/4" holes -
Hayes 18
Hanly 18

Bad - While the pneumatic support is nearly perfect there seems no way so far to use it under conditions we work

This is a very poor showing for Rubber, But probable if it was dropped in water so as to force rubber against plate it would be better,

We now put in a plain ¼ tube without diaphram End + Plugged, to see if we get much sound from outside the phone diaphram

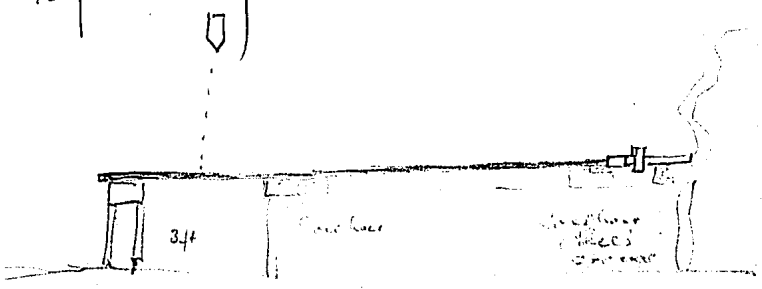


Hayes 20
Hanley 22

July 8th 1918

No 1 3 Stage

Solid ½ brass rod – phone connected to rod by 3" rubber tube, Water drop 6 ft. 10 ft along rod.



Hayes over 60

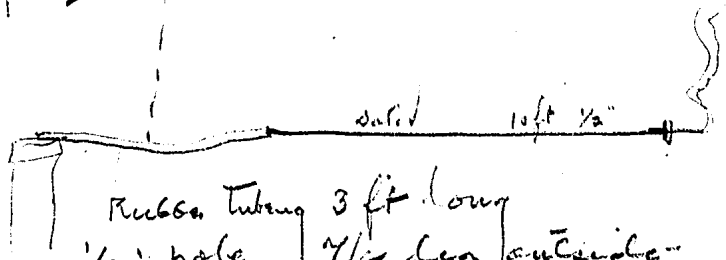
Hanley " "

We slipped piece rubber tubing over solid rod for water to strike on 1/16 walls

Just as loud ! !

We must find out if sound waves are longitudinal along solid rod or ~~[illegible]~~ waves travel along rod like a Chicken Carpet.

No 2 6ft



Rubber Tubing 3 ft long
½" hole 7/8 clear outside

This to find out how this rubber conducts

Hayes 34
Hardy 32

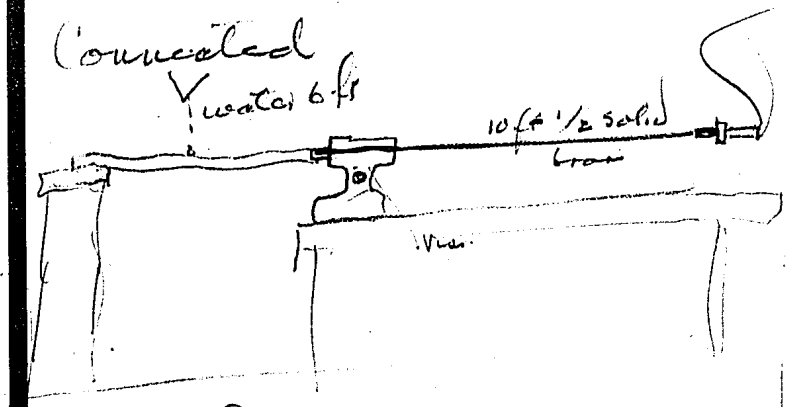
Very dull – would not be so bothersome as sweet one pipe.

No 3

Same as No 2 but

Rod clamped in Vise with rubber tube used in 2 expt

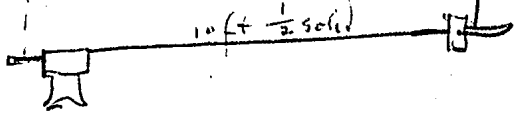
Concealed



Cant hear

No 4

Dup of #3 but
Rubber not used solid rod
Extends out from vise 2."
Water drops on overhang



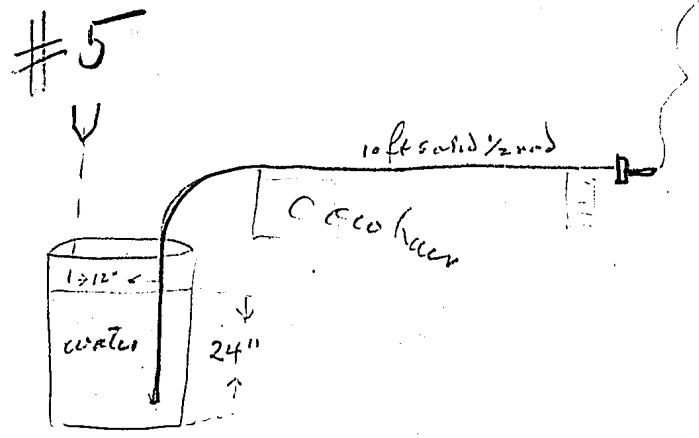
Drop hits solid tube 1" from Vise

Over 60 ?

Even louder than any

[redacted]

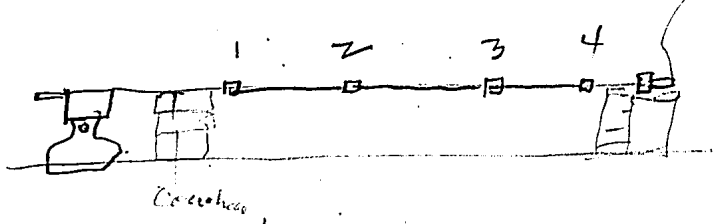
#5



Can't hear only whirling bubble bursts.

The Explanation for this is that the flow thru water is spread over large area & tubes don't get $\frac{1}{100}$ th of what it would get if drop shrunk down.

#6



Solid pipe ½" clamped in vise - overhang 1" drop strikes at end 3/4 from vise - #1, 2, 3, 4 are chunks of lead fastened to pipe to break up transverse waves from round traces this way

Hayes 48
Hanley 50

#7

Dup of #6 but a rider of lead sheet 3" wide 1/8 thick weight 1 lb – 2 feet from vise –

Hayes 48
Hanly 50 No impressions

Dom #6.

#8 Dup of #7 but 4 lead sliders – Each 2 ft apart along solid 1/2 brass rod –

Hayes 50
Hanly 52

Moved riders so spaced
irregularly along Rod —

Hayes 50
Hanley 50

Put Cocohair supports along
3 supports besides plane
on another Table —

Hayes 50
Hanley 52

Water dripped from rod to
Table, act was ahead so
water dont drop on Table.
as it might have dent waves
from Table

50
52 — Same as above

#9

We have use a lead pipe 1/2" hole 3/16 wall with plane on end. + plugged with Cork. Its held in Vise 2" overhang strikes about 1" from vise pipe seats on Cow hair.

Over 60

quite rancid - dull but (ac)

#10 We now Extend pipe outward so overhang 3" drops thicker 2" inches from Vise –

Just same Conditions as #9 –

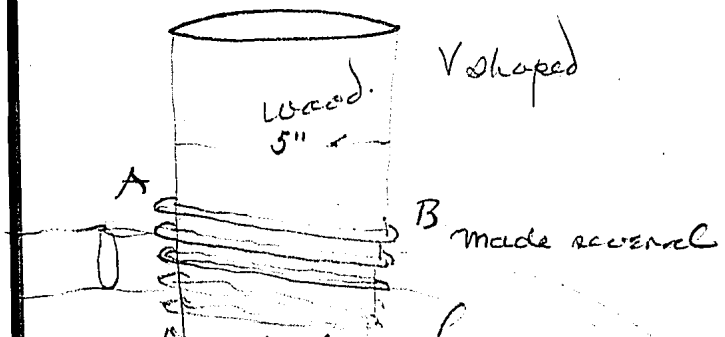
#11 – We put back 1/2" brass pipe 1/32 walls – 3 Cross bar supports – pipe in Vise 4" overhang – over this is 4" ~~pieces~~ big brass pipe with pneumatic Cork same as 1st used Water drops 6 ft – no sound over

#11 If Cork taken out we get

Hagen 50
Hardy 50

We now make a ~~[illegible]~~
about 1 ft. Drop off.
End of tube plugged
get nothing.

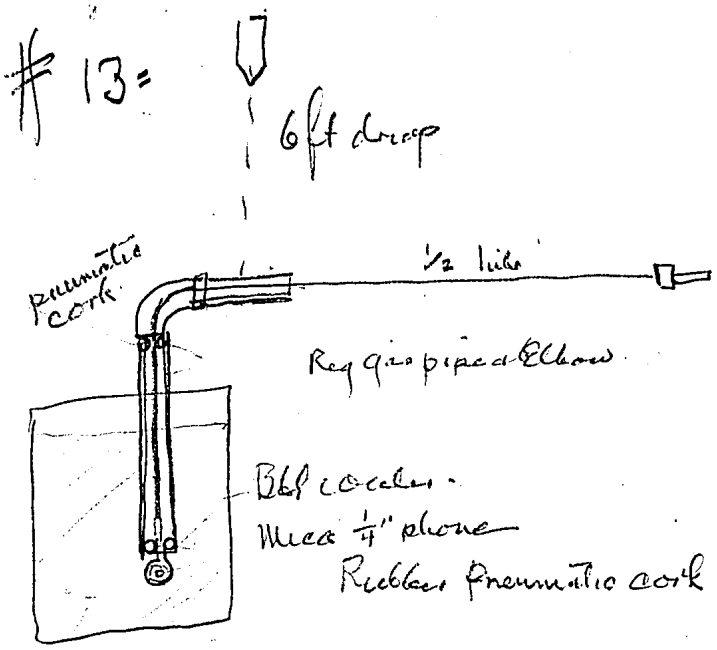
12



pieces ten set at angle
width of ledges $\frac{1}{4}$"
3/4 inch stream at A threw
stream drop B up -
no water run upon inside in
either case I placed on
plain board it did run up
1/2 inch at output end
This looks good, will mg
up tank & wheel on arm
10 knots threw water

Hayes had his hand over
dia Cant hear anything
Hearing Sound Came
from air -

13 =



Hayes
Hawley

More Than 60
A little water got in

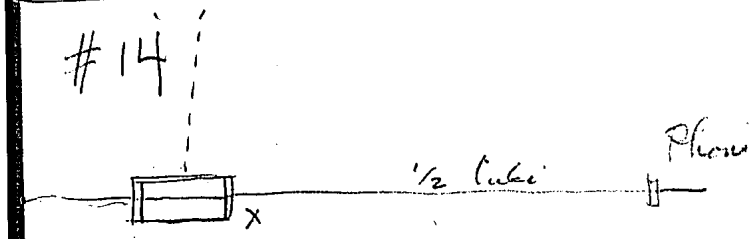
Pop of Diaphram holder nearly
touches pneumatic tire cork
Fired in air same position
Hayes - 34
Hawley 34

probably sound of
drop goes in air

13 by dropping on the surface of the water 12" away

Hanley 38 -
Hayes 36 -

14



X 4" long

plugged — X 2" Brass pipe

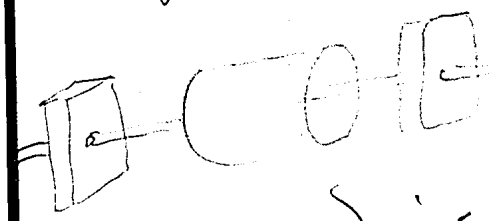
1/2" pipe passes thru Center Rod

Corks with holes in to support tube — Corks tight on 1/2" pipe but rather loose on big pipe

Hayes 54
Hanley 50

#15

Dup of 14 but instead of neg cork ends used rubber sponge at each end



These squeezed in ends of 2" brass tube -

Cant hear anything!

This is a better thing for me than the pneumatic as it packed enormously tighter. + is far wider -

#15 Continued – poured water on Ends to get water in sponge & tube –

Cant get anything on 3 stage.

Cant get any sound

6/900/112

July 8 1918

#16 — of 15

Duplicate, but use iron pipe 12" long 1½ inside diameter, managed to squeeze the rubber sponge in with ½ pipe passing thru Cinder. Went in very hard —

Hayes 44 — 10 pm & very quiet
Hanly 46 — 6 ft drop

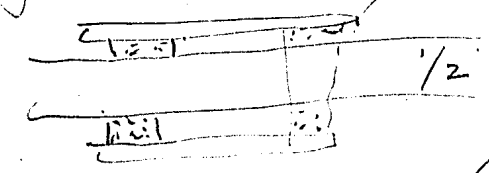
This is packed far beyond what we shall need — 100 grams per inch is all that is necessary I think It is to put a very quiet —

#17

1" inside brass pipe, 1/16 wall

8" long put in 1/4" lodi

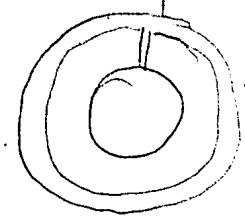
pad rubber each end 1/2 wide



Drop 6 ft -

Hayes 50

Hardy 50



Wont in quite hard.

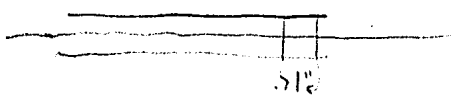
This wont be good as sponge

18

We now use iron pipe 20" long 1½ inside – using two thickness of Lodi rubber – 6 ft drop pipe in loose – sags only a little – width or length of cork ½

Hayes – 40
Hanley 42

We now make cork 1" long



1st load only ½ long

Hayes 40
Hanley 42 Same

(to be finally tight now)

#18 Continued

102 now make length of Rubber 3" - so weight compression it very much less -

Hayes. 54
Hanley. 52

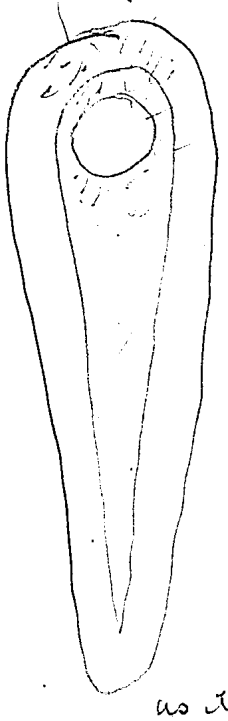
Neiosheme

#19

Soft rubber cylinder

Eft drop

½ Eft drop



1/3" tube

1/32 sheet brass

as its narrow some droplets 1/32 dia spatter on pipe

Hayes 40

Hanley 40

#20 . Dup of 19 Except added wt of lead

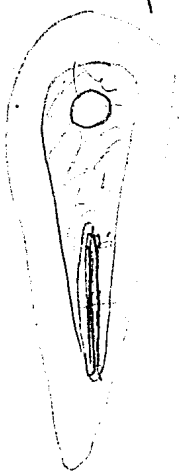
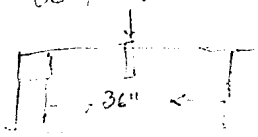


plate of lead wt 1 lb –



Hayes 34
Hanly 34

We now support lines 2 ft centers

Hanly 40
Hayes 40

Its not opatter as shielded
lube from Opatter –

We now move req pipe to one side & lay another pipe ½ × 14 near it 1½" from it & let water strike direct on dead pipe to see if sound comes thru air —

Hayes 48

We need separate dead pipe 6" away & drop on it —
both pipes are on same Cowhair —

Hayes 26
Hanly 28

We now lay live pipe on Rubber sponges & drop on dead pipe —

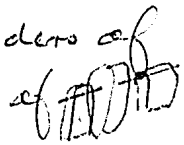
Nothing —
this shows shock went thru cowhair supports

#21. We now use only
lower tube and drop on

but whole thing phone
still supported on
sponges of nucleoi -

Hayes 46
Henry 50

We now put riders of
lead each side of



1" from

Lead 2 lbs Each, bends
pipe considerably

Hayes 46 Metallic ring gone
H 50 Little duller

#22

We now fix phone thus

H+H, 46-50.

We now (dep of 22) lay a rider over

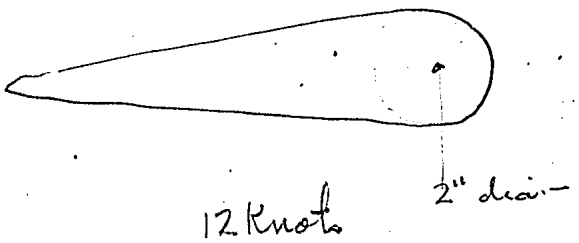
Water dropping on rider to see if Mice stop it

Hear nothing

This shows value of mice possibly lack of Elastic in hem

Data -

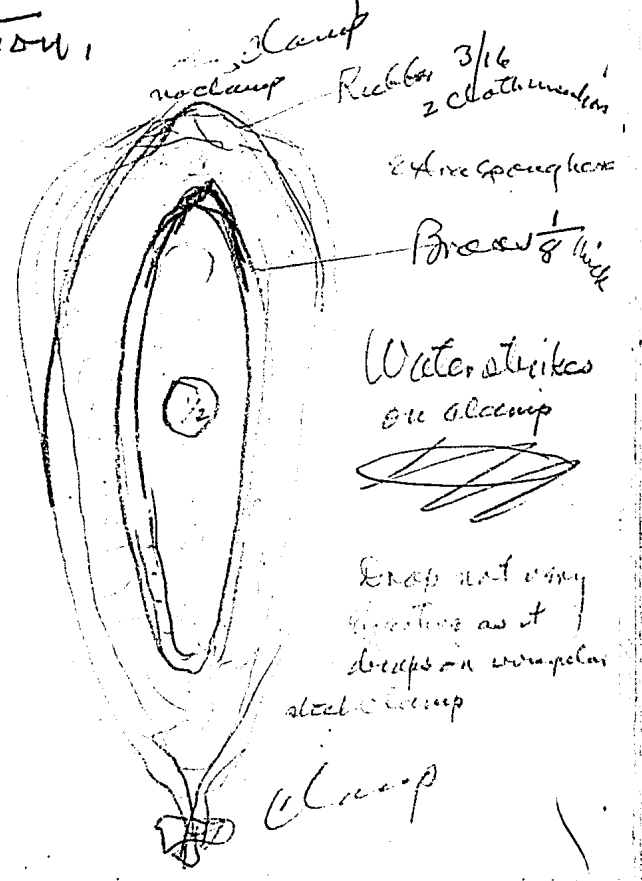
a plate having 1 ft total surface immersed & pulled along in water gives a torque or pull back at 12 Knots of 1.4 lbs per sqr foot.



pressure on head is 5.32 lbs per inch of heighth but when under water so back end or lodge compressed then its only skind friction

See page 1 Kundson

#23. We now try another section.

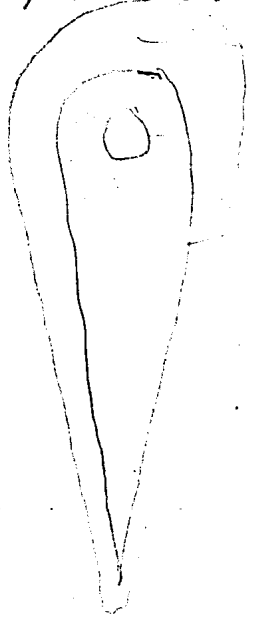


Hayes Handy Walking

This shape is nearly form we want

#24-

Sheet iron -



longer element of sponge at keel

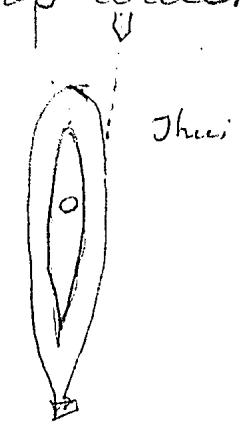
sheet iron thin

Hayes 18.
Hanley 16.

Very dull hard to tear -

#25

Same as 23
but we drop water on
angle



Hott Nathing —

#26

Drop 25

↓

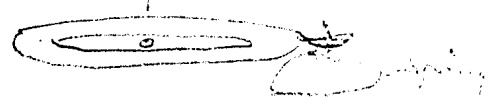
Drop water flow

Hayes 8
Hensley 8

Very dull & hard to hear & then only in absolute quietness –

Drop right over pipe –

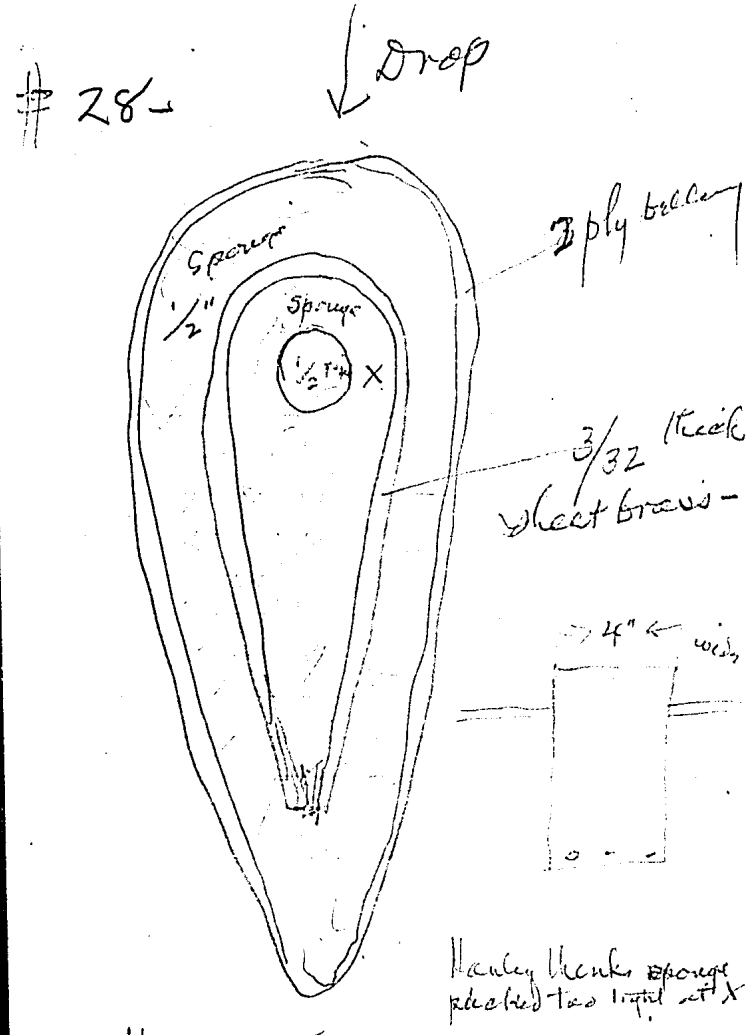
#27 –



Hayes H 10

Had to listen long while to get it very very dull

28 -



Hanley 28
Hanley 26

Very dull sound.
Very hard to hear

Page X -

Water thrown against carrier at + above water edge is not compensated for by wedge shape of carrier, hence if the blow is spread over 4 inches the blow will be approx 20 lbs against the head of 2" circle

X

as this is already we must have outer sponge section under a compression of 5 lbs per inch of height of carrier. X

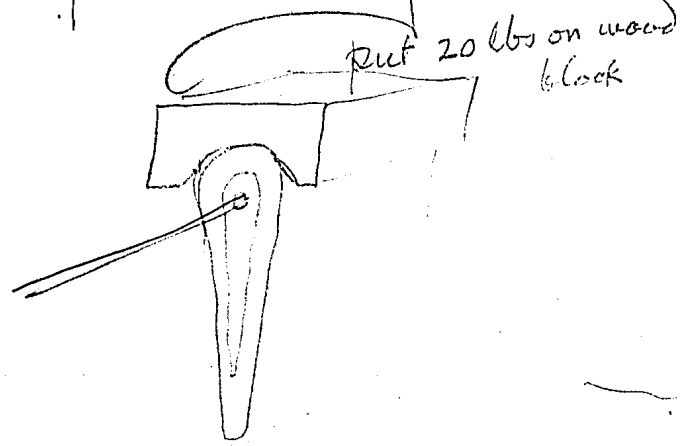
Moment compensated

a wave breaking against sides 10" wide of carrier moving 10 ft seconds gives total press of 755 lbs

#28 (Continued)

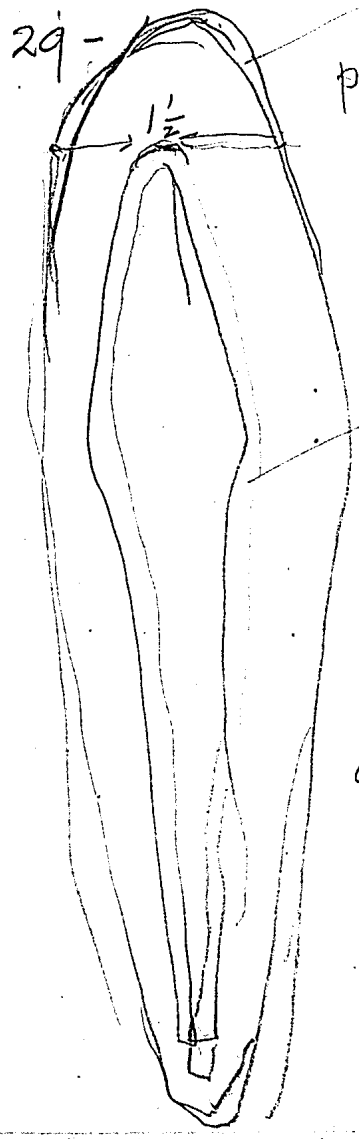
We now packed sponge at X i.e. little loose -

get Nothing =



This doesn't compress over $\frac{1}{32}$ with 20 lbs - but its probably not a fair test as wooden construction.

29 -



2 ply

packed more on End X -

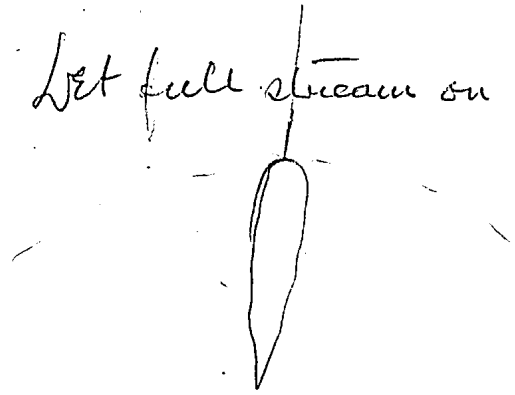
This is practically but can be made more pointed yet

full ⅛ Grain

Cant get any sound left drop on Edge

#29 Continued

Let full stream on top



Spatters 6 ft away

Hanley 20

Hayes 20

Very dull sound

Strong sound all thru room —

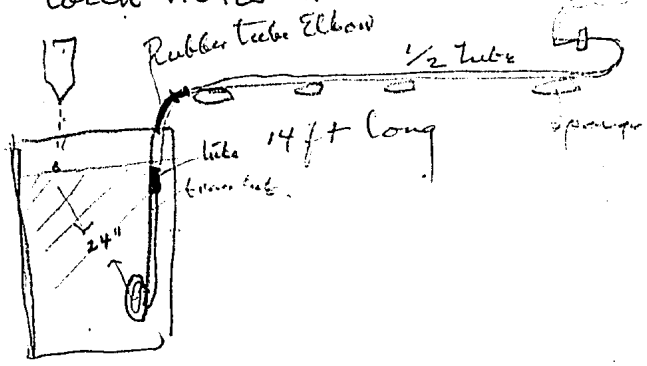
probably noise in room -

probably outside noise varied -

30

Experiments with Receiver -

def thickness of mica 1½ 1 + ½/1000 laping on plates with holes in -



1 3/16 dia 1½/1000 Drop 1"

Cant hear -

3" drop get 12 on box but very weak

9 pm - some noise around

We now drop 6". hear it sometimes around 20 but only sometimes -

#30 Cont'd

We now drop at 1 ft.

Hayes 48

Hanley 50

Window in the listening room was open — + big room

We put it back to drop 9" —

We close windows in big room + in listening room —

Hayes 46

Hanley 46 —

By closing windows it got very quiet,

We now put it back to 6"

Hayes. Can't hear steady drop, only bubbles +

Hanley

#30 Continued

We now put it at 8" water drop.

Hayes 46
Hanley 44.

8" Drop

2 mch diaphrm — 1 1/2/1000 mica

38 1/4" Holes

Hayes
Hanley OVER 60

When the boys said it was over 60 on boxes I couldnt hear a sound at Zero on boxes showing conclusively that on boat when I could hear to 6 + very loud at Zero. They couldnt hear to 50 @ 55 - The boat noises probably made their ears several times less sensitive Hence Value of BOOTH.

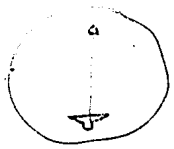
#30 Continued

We drop now at 6"

Hayes 54

Hanley 56.

In these tests diaphragms face the drop



The gain by big dia is scarcely of any value, in fact there is no gain although it was in proportion to area it would be 3 time louder

July 19th 1918

#30 Continued —

We now put back the 1 3/16 Standard Record but instead of 1 1/2/1000 mica we use 1/2/1000 mica —

6" water drop —

Hayes 48
Hanley 48 —

No advantage in 1/2/1000 thick dia over 1 1/2/1000

There is an Error running all thru #30 Experiments

Think these Expts
Satisfactory

#30 Continued

as we had a rubber tube
joint on the tube + this
joint was down in the
water + acted as a
diaphm -

We now put in back in
bbl - plug the end where
diaphgm is + depend
on the rubber tubing
joint to act as a
diaphm -

Cant hear anything

		½
3000	4.3 inches	2.15
2000	6.42	3.21
1500	8.6	4.3
1000	12.96	6.48
800	16.2	8.1
500	26	13.
300	43	21.5
100	129"	64.5

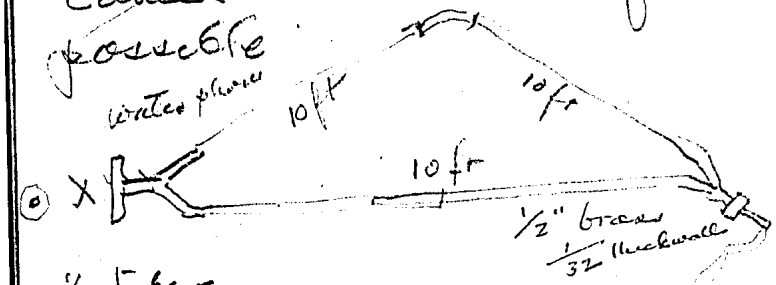
Later

Nearly all the Experiments following this for neutralization were faulty as we later found that the tables conducted the sound to phone & when tables small acted as sounding boards & our results due to jar small supports & sponges stop it

Experiments. July 11 1918

No 1 Expt

to obtain neutralization of sound from observers screw propeller & boat noises that enter water phone & to cancel them out as far as possible



½ tubes –

water drops on iron 2 ft away from diaphram –

Diaphram X is 17 Hole plate 1½ Mica Water Receiver

1st	48 –
base 1 ft. longer over 60	
base as 1st	– 48.
½" longer than at 1st	46
1" "	44
1½	42
2	42
2½	42
3"	44

OVER

No 1 Expt Continued

$3\frac{1}{2}$	48
4	50
$4\frac{1}{2}$	50
5	48
$5\frac{1}{2}$	46.
6.	50
7"	44
8"	50.
9"	50
10"	52
11	50
12.	52

note changed to inches

We now go back to Zero point and take a reading then go in by 2" increments

Zero start. 50

1 Expt.

2" in —	46.
4 —	46
6 —	48
8.	48

Don't seem to be much neutralizing — but the sound going thru long side arrives at phone louder than short pipe hence this interference.

We disconnect short pipe & let sound go thru it only to get value on box

Hayes gets 44 -

We now disconnect long side & put in short side

Hayes gets. 50. -

We now take out diaphragm plug hole get 44 $ $

This shows its going thru
pipe or table when the
diaphm end was screwed by
wood clamps to Long Table
it acting as sounding board
The speaker voice equally heard
in all parts of the room —
We need disconnect from
table, place all on sponges
diaphm hole plugged
get 44 Strange
We had a cork, went in 3/4
We need substitute a solid rubber
cork — 44 ?

We now disconnect phone Entirely & plug the end of a tube 4" long Expanding outwardly to put soft rubber tubing on

Get nothing

We connect long 1/2" brass tube 10 ft BUT LEAVE CORK IN PHONE 4" Tube

Can just hear when 60 x 20 zero go to 2 feet,

Thus shows it comes thru air in pipe —

The tube is connected to the diaphrm holder by rubber tubing at diaphrm — this may act as a diaphrm — disconnected it & plugged end of tube.

Get 44 — The $\frac{1}{32}$ walled tube must act as a diaphrm —

I think the water phone not good for this not enough power in air waves

WE NOW substitute Reg 1 3/16 mica not backed up by 17 Hole plate.

This dia on end of 10 ft tube

Hagen gets only 56 - but phone is connected to a Walter Miller Valve

We now connect direct to tube by rubber - butts within 1/16 - OVER 60 !

We now put in 10 ft tube 1/2 hole 3/32" wall — plug then end + see if thick wall ~~[illegible]~~ acts like 1/32 wall —

Get Nothing

Showing we can't use thick wall tubes like 1/32 on absorb

We now attach the diaphrm -
(not backed up by 17 hole plate)

Above 60 =

Hereafter consider no tube of 1/2 inch inside that has cost less than 1/8 while 3/32 tube 10 ft didnt act to give a sound due to water drops falling on a board from heighth of 6 ft.
board 7/8 - thick 3" wide laying west edge of water 6 ft - phone end 2 ft from point where

All this later on may be incorrect a we have apparently proved that the table on which phone rested is a sounding board + that phone to aid a defective ear

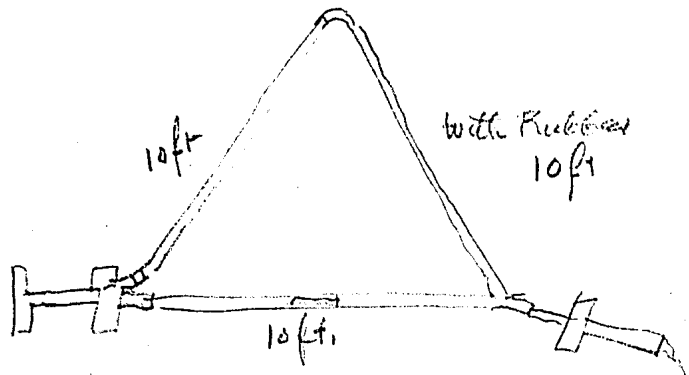
With good phone + on sponges + water end plugged we get nothing -

We dont get anything when 1/32 tube used

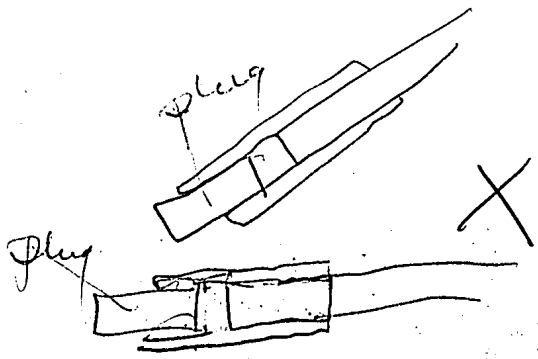
water drops, This volume of sound which is clearly heard all over the big garage room is insufficient to cause walls of tube 10 ft long 3/32 thick to act as diaphr. To cause air wave to travel in 10 ft tube to Bellphone + 3 stage and when other end plugged might so act if the sound was several times louder like on a boat + therefore 1/8" walls is safest to use when bore is 1/2" — See Note

not so

We now make a new equalizer



1/2 bore brass tube 3/32 walls
rubber connectors as short as
3 stage, water drops 6ft
on 7/8 board 3 wide laid
across top of water bbl.
Diaphm m phone - get
Hayes - 50 on 60x



We now plug end of tube at diaphragm —

Hayes gets 32

When we should get nothing

We now support all the 3 tubes on sponges

Hayes gets 50 on Box ?

We take the 2 tubes at Diaphrm end off Mullers Valve + plug Each separately ~~but~~ put plug in the rubber connectors

Hayes gets 34 but later found 2 holes in cork

Put in solid corks (Fuegos)
Hayes gets 32

We now remove rubber tube
Connectors at the 2 pipe ends
at dia & put ~~on~~ corks
directly into End of Green
pipes 30

We take out all the Sponges
Except where phone rests
Hayes gets 30.

We now only use the 10 ft
tube plugged at other End
Connected phone ~~& extra~~
took off Y
~~Connected Clamp [illegible]~~
Hayes gets 30

It laid on table we now put sponges under -

Hayes-gets 30

This dont drop what we got before with the 3/32 pipe which was 2. However present pipe is split & has small piece 1/32 wall 1/16 inserted but not seen

We not use continuous 3/32 wall pipe as in original experiment,

Hayes-gets 30

Very Strange

We disconnect phone + plug it to see what we get,
Hayes gets 24

We take off Ear phone + expose only the Magnets phone
Entirely disconnected from everything but rests on sponge
Hayes gets Nothing

Note = Until we can get phone itself when plugged to give no sound in 3 stage

When 18" from water
drop board its a defective
instrument & will
throw us out We now
try to get it sound
proof when plugged
With a better head for
pouncing tube Hayes
gets 8 on box

We now advance phone
10 ft toward water
drop board - now 18"
from it — Hayes gets 10
Very strange law of sound * dont work here

* Sound not so far transmitted
by long table,

Phone held up by Hanley holding Cord –
Hayes gets nothing –

We put phone back to old place 10 ft on its table place on stanchions + move long table 4 or 5 ft away + take away pipes

Hayes gets NOTHING

It was the table that did the big – will remove it +

use seperate small supports + bring phone up to within 18" of dropping –
now done

Hayes gets Nothing

It was the long table

Under these conditions we lay a 3/32 tube 10 ft long connecting the front table with the phone table –

Hayes gets nothing

This appears to show tube dont conduct from one table to the other – tube lays on wood of table

We now connect this tube to phone = its plugged at water drop end 4–18" from drop + unsupported in middle between tables,

Hayes get 42

this with rubber cork

We substitute Reg Cork Cork

Hayes gets 42

We now lay the water end of tube on a sponge support.

Hayes gets. 42

We now put 2 sponges for support.

Hayes gets Nothing

We remove the sponges from water end of tube.

Hayes gets Nothing

We change support of phone by sponges in different ways Also lay on table, -

Now on table 34 on bot

Now pipe held by sponge phone over Column — book gives nothing

See Book
2

Notebook Series -- Notebooks by Edison
Notebook, N-18-07-11

This notebook is a continuation of N-18-07-02. It was used by Edison in July 1918 in connection with his work for the U.S. Navy during World War I. Many of these notes were made in or near the garage at Glenmont, Edison's home in Llewellyn Park, New Jersey, where he was working with John A. Hanley, William A. Hayes, Sherwood T. (Sam) Moore, and other employees on a series of experiments pertaining to the measurement and detection of sound under water. Included are tests with various devices used to pick up and amplify the sound of dripping water, possibly as a way of compensating for the interference experienced in listening to a sound detection device as it was towed behind a moving vessel. Other tests involve simulated submarine sounds. Among the components employed are brass and rubber tubes, telephone receivers, microphones, reverberators, and audions. Some experiments involve sounds transmitted from within a large iron annealing pot procured from the Edison Storage Battery works. The experiments are continued in N-18-07-18.2. The cover is marked "No 2." The pages are unnumbered. Approximately 120 pages have been used.

July 11 1918

Continued from Book 1

We rest phone & tube on Table & hold water end in hand
Hayes gets 30 –

We put in 1/2" 1/32 wall tubing phone on sponges water end plugged & resting right on small table. –
Hayes gets Nothing –

Phone on table no sponges
Hayes gets 30 ..

We now put phone on sponges, the water end we put on diaphrm no hole plate used + support pipe on sponges

Hayes gets over 60

We now move phone 4 ft away should be over 4 times weaker

Hayes gets 56

We now move stands so phone is 78 inches -

Hayes gets 56.

Must be some Vib transmitted

We now put 2 sponges at both ends one on top of the other

Hayes gets 56
Hurley 56

Square distance dont work
Something wrong —
We now remove diaphram
+ plug hole in Tube.
Hayes gets Nothing

We recorded on phonograph white wax the sound due to a drop of water falling 6' ft

Used a very sensitive recorder 2 1/2/1000 Ohm - Water dropping on rig board across bbl + using 6" mouth 2 1/2 ft funnel, Could not get any signs of a record — funnel within 1/2" of Edge of board —

Edison Could not hear a sound when listening in funnel but heard the thud when pencil resting of board + held in teeth

the Boys say they hear drop loud all over

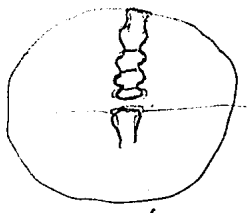
room & even in listening room with both doors shut

Finally we used a 2" dia 15/1000 Mica & let the water drop drop dually on the dia.

Phonograph - 100 Rev min - Circumference of 1 Rev on max 6.75"

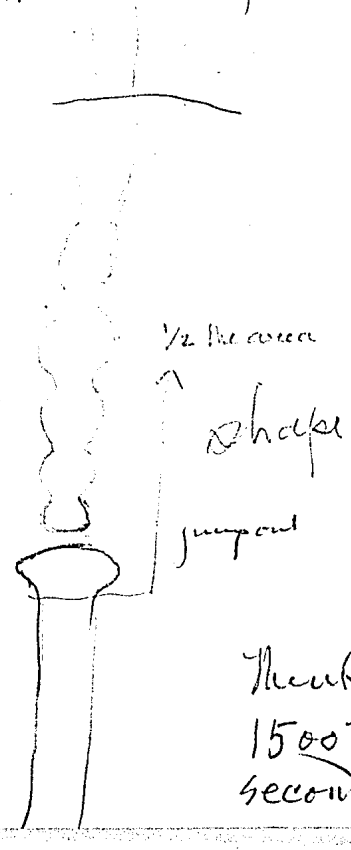
Dia of objective of micro area 1/10th of inch -

The bunch of rapid waves due to one drop reach 1/2 way across the area. about 7



Short waves, each one longer than the other.

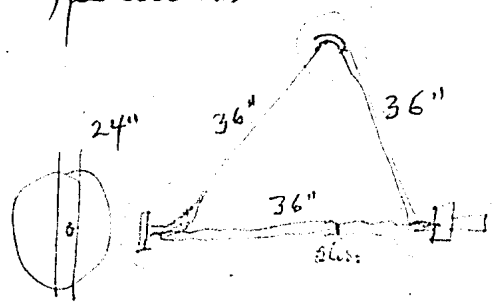
finally after the pronunciation
short vowels cease to be pronounced
a lot of short very needs ~~[illegible]~~
longer vowels can just be seen
if phone recorded on tape
but not many if phone held
in hand



think about
1500 to 1650 per
second

Expt 2 July 12 1918

We now resume compensating Experiments



Tripod supports – lead on sponges – 1½/100 Mica dia – no hole plate – drop falls 6 ft

Plugged hole in receiver.

Hayes gets 46

Harley 46

We shut all windows & doors leading to testing room 46 ?

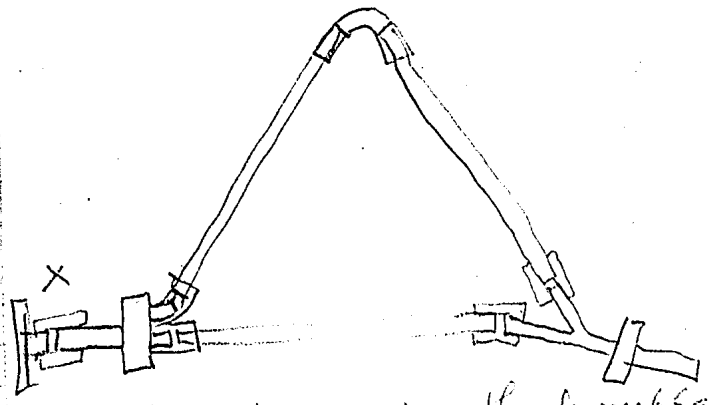
Under Exactly same conditions of dropping — 6 round over 66 & 6' ft drop. They now say they hear it in Listening room thru air walls or floor vertical audion —

Of course they always have heard it thru Even when they separated from audion Nothing — Disconnection of mechanism & brain accounts for this —

We now try stethoscope tubes to see if we can shut out jarr of drop — getting to ear —

Have just found that thin rubber tube joint in △ acts as diaphram

WE



allow ~~[illegible]~~ use thick rubber for connections, tubes nearly butt, 3/8 @ 1/4"

Hear to 28 – This has improved it, We now solder phone at X to Brass Outlet + test. 28 ~~on~~ Box

WE put sponges under the board that water drops on get 28 on box

Without audion, listening in
Listening room doors & windows
Shut board on sponges
where water drops can't
hear anything

but without sponges can't
hear with disconnected phones
connected to ear, but listening
in room can just hear
as there is some noise outside
probably it would be strong
in Delaware.

We now do away with rubber
joints & solder the triangle
tubes together making

the path twice as far one way as the other, -

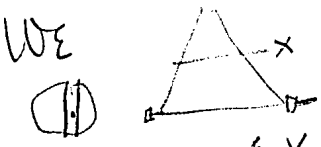
Hayes 43
Hanly 44

Water direct on 66°

Day it rings like a metal now. has lost the dull thud it had before —

We put water board on sponges at 66°.

Hayes 44
Hanly 44

We  put a wrench across pipes at X

44
44

We put 1st tripod legs (holding the microphone receiver) on blocks wood on springs –

Hayes 38
Hardy 40

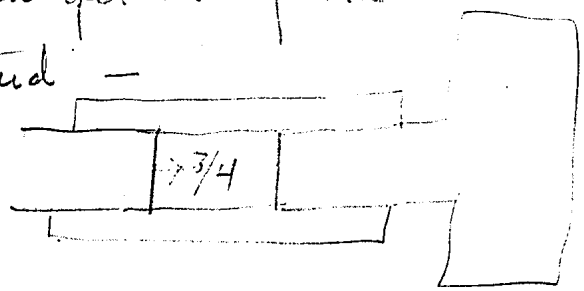
With Valve at X

We cut off all column at X.

Hayes 38 –
Hardy 40 –

Its a musical sound due to sound waves striking metal

We now saw off Bell phone & put on a rubber tube joint, to see if we can get rid of the Bell like thud —



This may act as diaphram - but it may change the sound of music character.

Hayes 32 — its still musical
Hanley 32

Note

later, it may not be the lead

How small a air leak into a closed system will produce such loud results both in circuit & direct by stethoscope,
all joints should be covered by Rubber or tape

We now cover the pipes with one layer of black tape put on Diagonally

Hayes
Hardy

NOTHING

The slot where we adjust tube one inside the other was covered with tape in above Experiment where we got nothing. When we took off tape to expose joint got for 2"

32 on box — after retaping got Nothing

The great trouble we all have
Experiments is that say 1 o'clock
you get 40 on both at
2 o'clock nothing at 3 o'clock
40, Solely due to outside
noises affecting the hearing
The only way is to use a
sound proof booth.

We now take tape off of
all the tubes & only tape
the leaky joint.

Hayes
Hanley Get Nothing

We now take tape off joint
& are just where we
started ie bare tubes all
soldered except one rubber
tube joint at Magneto Phone

Hayes
Hanley Nothing —

This is rotten before under same
conditions got 45 —

Cant find where it came from probably at adjusting Valve or Mullers Valve at water end —

In any event we can get rid of it —

We took cork out of plugged end at Water phone + got water 60 on box ditto when Muller Valve turned so only straight pipe got water but we didnt punch off the ^ other Bellphone

end –

We are going to lower
drop to 2 ft to weaken
second Gacon 60 on 60x

Hayes 50 Valve shutting
Hanley 52 off

We lower pile so it
drops 1 ft only

Hayes
Hanley Can't recov

We put it up to 18 inches
(12) the drop distance
Hayes 40
Hanley 40

We now close valve so triangle complete to see if it lowers round,

Hayes 20. only when dead quiet
Hanley only get at intervals

~~We disconnect the triangle at Hanley valve and valve~~

We now use a single separate tube

Hayes 48

Hanley 46 –

We now put back triangle

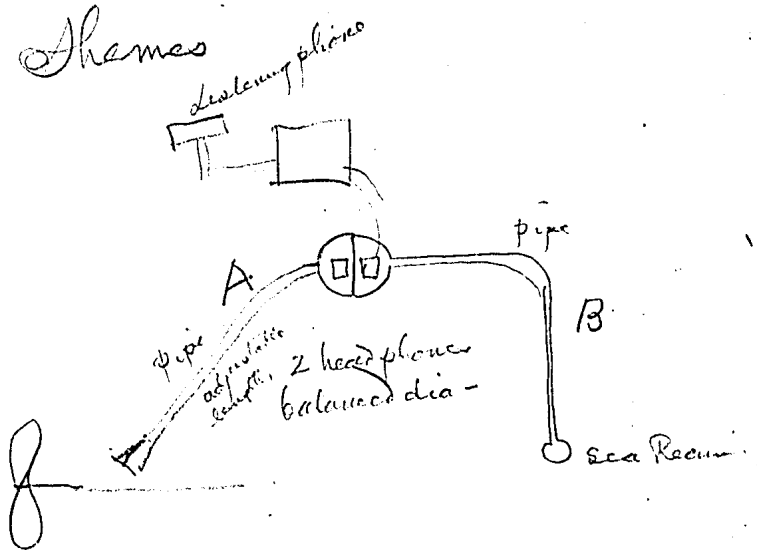
Hayes, 24

Hanley 24

Very hard to get accurate movements close at times

This seems to work

Themes



Boat screw noise read up B
ditto duplicate up A -
+ A adjusted to reach
dia at same instant, are
balanced out but any
noises at a distance like
a sub or torpedo the
is out of balance on
balancing phone next page

We now make a triangle
Each side being 1 ft - all
soldered with true pipe at
Each end to fasten phones on
rubber tube -
being used to attach true
phone -

We plug water end of phone
and see what we get

Hayes Nothing
Hanley

We now take plug out

Hayes 50
Hanley 50

No

The bug in this is waves received from water phone & from shaft mounted boat are as to component waves probably unlike & therefore will not balance of their shapes & sequence were the same it would be ok but its very doubtful

The practical short circuiting of listening phone at the exact moment they reach listening phone seems only practical method over next page

As Cargo boats give 1 Red
Seconds
+ slowest speed of sub 4 knots
give 2.3 per sec + over
6 when observing position
for firing—
There is a great difference
the Cargo boat gives out
the second only 1/8 of total
time, 87½ of time of
chase is due to heavy
submarine,

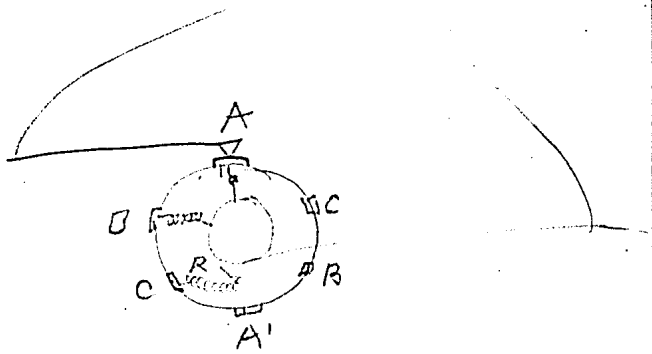
Here is a scheme = suppose
we had a rotating device
giving say from 120 to 350
dots of sound per min
imitating Morse given by a sub

If this was adjusted to a certain rate its power regulated so it couldnt be heard amid the general noise, supposing the sub was in vicinity of that couldnt be heard amid general noise,
If now the artificial bell was increased in speed it would at some point equally commade with the data of sound given by submarine & the two added could be heard,

See next page

should use not use Audion
a central wheel on
shaft could be provided with
a circular battery whereby
at the listening stethoscope
The tubes could be pounded
down by a magnet at
the exact time the sound of
our own voice would be
heard & thus eliminate it
and adjusted so it would
do it almost exact laq rate
Possibly a shutter could
be used with slit so at
moment when sound
should be heard the
shutter closes off sound
& it must be quick at
least could use
Parsons grid valve

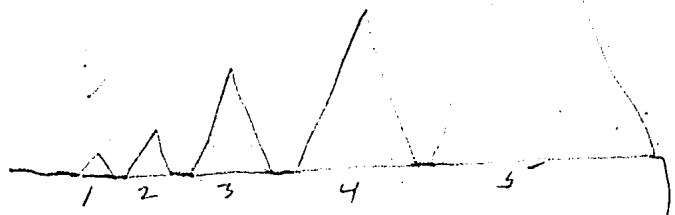
For shortcircuiting on shaft provided this



A A' has very little Res
B B' More Res
C C" still more corresponding to their different strength of sound

These Resistances rotate with the shaft & all are connected to ring

Scheme to make an intermittent sound
Continuous



a group of leaders each 1 ft long
but 6 leaders in group makes
group 6 ft long
No 1 triangle is 6X12
hence the group on exit well 6E
12 ft long - allen Exit from No 2
24 ft long No 3 48 ft long
No 4 96 ft long No 4 well 6E
192 ft long + funnel Exit from
No 5, 384 ft long
by used 7 triangles it would
be 1000 ft or more a 6E continuous
next page

by the lagging effect of the triangle, the angle tubes being made slightly longer to compensate for twice the length. The volume or strength of lagging waves would be same as in straight pipe.

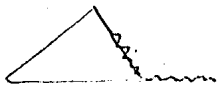
If propeller sound of 6 interruptions from a Revolution got to Ear from our own boat there would be plenty. The gaps of silence could be filled in by taking sound from another boat & passing them through a series of incrementally lengthened triangles ~~with~~ & passing them into the ear tube leading to the Ear then making waves from boat revolution sound

Conclusion.

Triangle neutralization scheme not very promising because sounds are not periodic & also occurs in patches not one of the vibrations of which is periodic or sample amplitude.

by using triangles - the short section of which is long enough to hold all the waves of a patch the strength can be reduced 50% as the volume is halved in splitting & one section passes out of short tube just as the other section joins the tail of

The other



reduce 1/2 the triangle & twice as long
by using an additional triangle
the short side twice as long
the Vacuum is weakened to 1/4
& so on the sound of sentinels
with increasing triangles
would become extinction

We drop this line of
Experiment for the time being
& go on compensating
for propeller sounds by
short field balancing
plan

July 14 1918

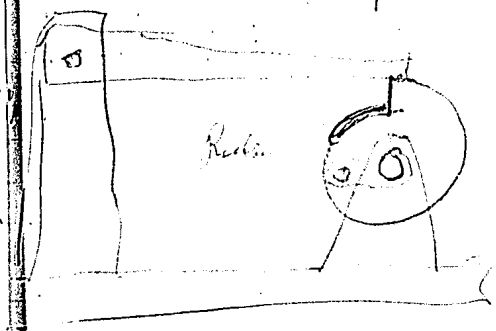
3 stage –

Receiving phone reg Bell. with metallic center holding a short 1/2 bore tube 4 used to put rubber tube on

Phone land flat on 2 Rubber sponges on top of a flared horn tripod of metal –

This is from room floor air or other sound when Helz plugged at phone even when using Receiver

We have fixed up the old wood Rubber wheels which I once used for making noise



2 of these used 1 in the Theatre room drops only 3/4" on Rubber with both doors closed. Keeper hears it OK 60 Rev Min —

When many gals of water drop from this box 5" into a wood box the bottom of which is thin acts as a sounding board

[Edison hears sound within a fort]
Hayes notwithstanding this
noise can hear Cam deer
in Meadows room —
Edison hears in Audion
the water moves very
strong being about same
as Boat under test conditions

WE have another Cam
noise maker which has
heavier lever falls a
greater distance & make
a great noise this is to
represent Screw noises
of Cargo boat,

We have on shaft a
wheel, on the surface
is a copper piece 1/9 of the
whole area. This piece
connected to a continuous
collector ring with
spring — There is
a spring running over
face of wheel —
Now when lever drops
at the moment the noise
is created, the circuit
is closed + then switches
the listening phone
so second is not heard
The spring must lag

$\frac{1}{45}$th of a second to allow
for loss of time of wave
travelling 25 ft from
room to Back phone.

Just tried a preliminary experiment
It is very ok but length of
sound is a little too
great for length of copper
on surface of wheel -
The trouble is that
whole expression comes
after blow.
after lengthening contact
we dont get it perfect.

Sounds like this III—IIIIII

III—IIIIII. No matter how we

adjust, We get phone up

close and get III only

We now think that we

balance or short out the

main sound + that

the Extra sound III—IIIIII x

x is the echo -

We now run wires out

100 ft about to center phone

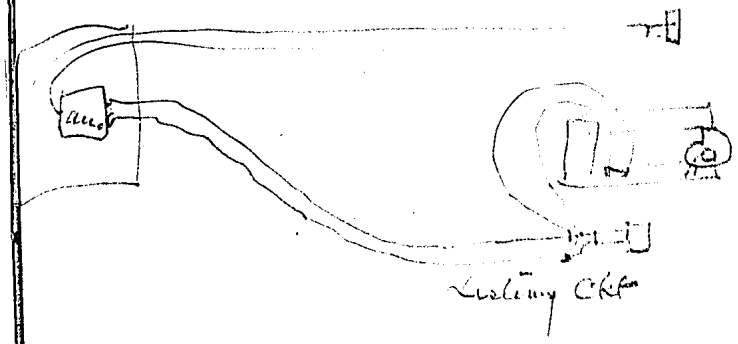
at garden behind garage,

thus

New idea.

The intermittent sounds from steamer is composed of a few non periodic waves around 1500 to 400 sec-
The group time according to phone is $\frac{1}{400}$th of a second
Standing flow wasted + no wave periodic the car is not resonant to the undamped waves + the whole is weak
If need we use a small chamber connected to the ear. The group will enter + reverberate by echoes + be periodic ~~so~~ (ie) the group

next page



This will practically cut out room echo.

is periodic + not like water

20 ft away Piano is turning
the Cam machine I cannot
hear it if I put my hand up
to extend my ear I cannot
hear it but if I form
my hand to form a small
chamber with 3/8 hole for
sound to enter I hear it
very loud, if I close
the 3/8 hole by a finger
from other hand I hear
nothing. closing chamber
removes the sound by
echoing or reverberating + gives
ear time

July 15 1918

We now have water spray
near Center of Garden
2 ft from phone mouth,

~~[illegible]~~

~~[illegible]~~ Piano not working

Cant
Hear (left drop. Sub)
hear 30 ft 9" away

~~[illegible]~~

~~[illegible]~~

We now have water drop
set 3 ft away from
phone - this is a little

More than 1/2 the strength of noise from the regular dropping going to phone —

Can hear sub drop lever at 25 ft - Burns not working

Water 3 ft Burns — ft

Sub limit still 25 ft

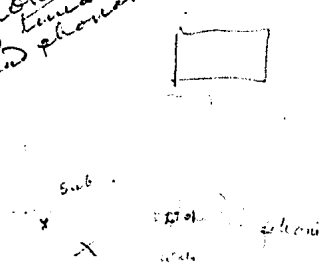
Burns lever doesn't latter. 70 times

Now phone 4 ft away from water -

Sub lever heard to 28 ft. 30, on box - something wrong

Bad arrangement we now change it out doors

Listening with
Stethoscope which
worked in 2 or 3 times
worker then had phones



Sub, water Burns & mouth of
phone all point south to where
get no audio from walls of
garage

Water 4 ft from phone
Burns 8 ft
Sub - 28 — 40 to 1.
Hear, sub on box to 30,

Sub 35 ft, Hear to 28 on
box — 76 to 1

Note that on account of auto action of Ear-whole a noise of 100 + one of 5 cant be heard a noise of 50 + 2½ is heard Ear + 1 of 20 + 1 is far Ear to hear 1 with 20 noise than 5 with 100 noise -

We not put Sub at 40 ft. Hear to 22 on box - 100 to 1

We now put Sub 50 ft away Everything else the same Here on box to 16. 156 to 1

We now put Sub at 75 ft. Hear to 2 351 to 1

No noise except air

We now stop Burns + also the water + see how far we can go with only normal sounds received from the air. at 75 ft hear to 34. 351 to 1

Sub 100 ft away hear on box to 20 625 to 1

150 ft. hear on box to — 12 1400 to 1

Sub now 200 ft away
Hear on box to Nothing

We go back to 175 ft.
Hear on box to -4- 1915 to 1

2.3 times further
than if Burns were making
boat noise & motor
noise was 10 kq-

Sub 165 ft & Burns only
working boat noise Engine.
nearly compensated but not
perfect on account unlevelly
turning & jump of contact
points, No water noises
Hear to Zero on box -

Scheme

Put tubes down along bow
wards & collect ends at
leaving end & use a regulator
this would make so much
noise all will be heard except

The present opts in continuous
water noises is due to 2 or more
gates combining to increase
amplitude, if 6 or 8 replace
& a reverberator is used. Hydro.
sound can be made continuous
& dimmed to almost
nothing –

165 ft for sub – water off
Burns off – only normal air sounds
Hayes turns! sub at same
speed as usual – then
1/2 this speed then twice
this speed – want to
ascertain if very fast is
more audible than slow –
Hear to come for all
speeds of turning. Hydro
says speed makes no difference

Put sub at 50 ft, water drag
+ Burns boat turning –
Hayes sub turns very then
faster + then slower
Slow + Reg speed hear to 10.
the fast one to 14 on box

We now ~~feat~~ on Boat sound
will shut the Control of engine
& make Coffee Control Even
with face of wheel so there will
be no jump to see if we can
get rid of the slight click sound
that comes at times —

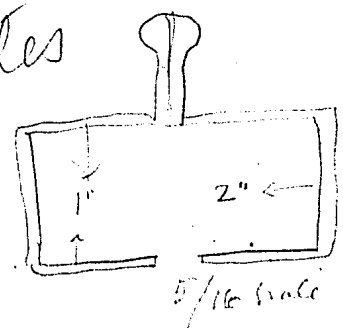
When Burns boat shuts
steel & shut off on of
he deaps. Lever by hand
can hear it very weak
this is either due to Echo
from Quarter or too
much resistance in shunt
Its probably the echo
Edison Cant hear it at all

This shows we certainly
can cut out Engine noise on
boat with 1/9 turns short circuit

Burns turns at 6 Rev men
with short ckt on cut cover
Throw back -
Hayes 165 ft is turning
sub — Then to find effect
if Burns short ckt of sub
can be heard or interfere

Can hear Known short ckt
clear but all noises from
over is cut, But this does
not interference with
the Sub

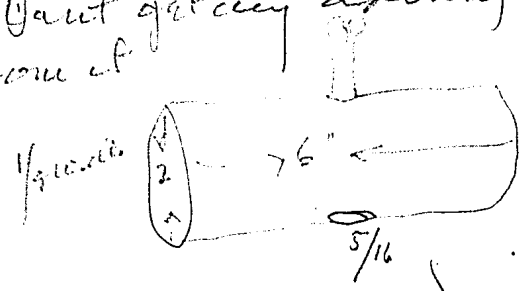
Notes



1/8" walls

Brass

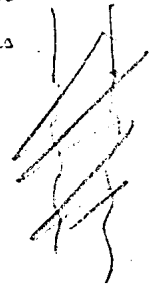
With this - I can hear several times strong a noise third like Burn Machine -
When I cant hear without it I can go twice the distance away & hear it loud -
YET Knowing Harley
Cant getting advantage from it



This mg. Kills Thud sound

Now Knowing with Burn machine turns as fast as he Can - While Harley turns Dub at Regulated to use of shortstroke more affect on Dub -
On account of Knowing Machine being as close to plane & sounds he generates in fast Turning cant hear Dub -

We succeeded second from
Brown Boat Cam Machine
with plane 100 Rev wax
Cylinder — area of objective
100/1000 — of one knock
duration of one knock
120/1000, 1/75 of a second
is duration or cylinder
would hold vibs of 75 vibs in
1.4 turns



11 To 16 Waves
Waves at rate of 1050
per second —
A The bunch of waves
Each bunch almost

a duplicate of the others
1 jump out in each —
2/3rd tracking width —

Every wave appears different
2/3 one twice as long as width
of tracking — 1/3 shorter —

Water shower dropping
on center of 2" dia
1/2 width tracking
~~Well~~ Many jump outs
Study it more

Now a single drop 6 ft
on 2" Dia Same as
in the room Echoes
Dont record There are

8 Vibs, Euchrone Longer ~~the~~ less amplitude - first to buy with tendency to jump out -

Vibs covers 1/3 the area 50/1000 - over 2500 per second.

Experiment with microphone + Bell phone comparing using a watch -

Water diaphram on Metaro 17 hole Mica — thick -

1 cell battery all out

Center of garden — Water from two box dropping 6 ft in a box same as use been using

Micro very loud on Zero
much louder than Bell -
but both go to 50 on box
so no gain by Micro
but a bad characteristic
when working near
Zero on box where we
want to work

We put on 2 cells on
Micro - 54 on box
dont seem increased by 2 cells
Bell gives 50 @ 54 -

The Micro has 2 diaphrms
its scour at end of channel
another Water dia Mica

Neuscheme

We Check phone men by
Water, run it so close
that all strong ribs are
supposed by black mat
running fast enough
Chalk running just
fast enough to Hecky
doubler work weaker

backed up by 17 holes.
Moore takes the 17 hole
diaphin so micro has
same chance & condition
that Bell phone has —
Micro now 60 on 60 on
boxes I call —
We take it further away
from drop water board
leaving Bell in same
place (16) 4 ft —
We now place Micro 8 ft
from Water drop — this
makes it 4 times weaker

Can hear it past 60 on boxes

We now shut water off to see what other sounds from the air, as it may be these sounds we hear - its very quiet at OK

We now go off the the Sub twining Pump 300 ft this represents a difference 4 times greater than the Bill which went to 175 ft all original noises clapped

Cant hear — too much
air noise —
We now go to 250 ft.
Cant hear —
perhaps Micro adjusted
too sensitive — our noise
make it fry
Nothing certain so far
in Micro Experiments recorded
to this point —
Adjusted Micro less sensitive
fairly quiet now — Cant
hear Sled at 250 —
at 100 ft. Can hear it
but Hanley hears it
direct with Ear in

take 14 ft ½ lubang go down to center of garden & see how far can hear Sub.?

Also – put in telecom Mics & input coil of Audion on induction coil with ½ or 1 ohm primary + 1 cell with 5 ohm wound of Rec. Then will give say 200 milliamp fixed contact steel with 20 ohm.

garage, Something is radically wrong with the adjustment of the Mics – or the Audion or Elsewhere.

I think trouble is that induction Res of primary of Audion Input Coil is very high – where the EMF from 1 cell + ~~too~~ vibration is too weak We should insert a Burnel Coil with 1 or ½ ohm primary multiplied with Audion input & add 4 ohm or more to prevent frey of Mics.

I put in 1 ohm Coil + 580 ohm Bunnell – the ~~[illegible]~~ Secondary of which is connected to primary of audion – also 5 ohm in, Edison heard on 2 of boxes. Where I can't hear anything from Bell phone on Audion – Harper talked out of range would on 75 ft from phone in Center of garden ~~[illegible]~~ It was louder to Edison when Bunnell Cut out + connected long wire to audion with from 5 to 100 ohm in series –

Edison Heard Well
5 or 100 ohm Res

Making little change in loudness but 200 Ohms Cut it considerable —
The whole trouble is Continuity which but better Edison Mask but is failed to normal Ear as its no louder than Bell to them —
Microphone should be of such a nature that on a 3 stage Circuit it should not give a fry but may give a perfect continuous weak noise like listening to the Ocean at a distance in a Conch Shell —

July 16 1918

Experiments with phones in open air no echoes –

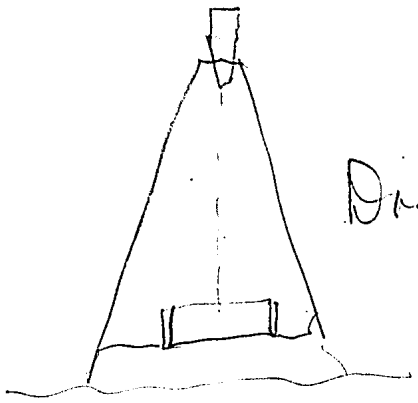
Receivers at center of garage garden –

6 ft water single drapper used on 2 leg bridle can of water. Thus to be moved along path gradually receding from receiving apparatus, to determine relative sensitiveness of dif receiving apparatus
Bell Magneto Bell Mono +
56 ft of 1/2" bare brass tubing
+ direct listening with stethoscope

All of course gets the normal air noise –

Use test Bell Magneto
Receiver in center of garden connecting to 3 stage
up in garage

* Moore in ~~top~~ Carriage hears it with Ear alone 50 ft quick dropping Moore hear to 75 ft -



Dropper

Moore hears by Ear at 100 ft,
" " 125
" " 175 -

Moore tested the whole range of Reverberation
Can get only now & then at 100 the drop
Natural Ear better, But he says it
amplifies other noises & gives a roar
he dont hear natural Chain -
Smallest "beat all around

Bell at Center of Gravelow

Water drops 50 ft away from Phone
hears when continuous stream
to 14 on Box -

* We now quick drop. at 50 ft.
We get it at 44 on Box (limit)

We now remove water dropper
to 75 ft from Phone
Hanley goes to 32 on Box

We now remove to 100 ft.
Hanley hears to 12 on Box

Now put Water dropper to 125
Hears on 4 on Box in quiet
periods.
with normal or noise
LIMIT

175 ft with plain Ear to Moore near limit of hearing. but he think he could hear further

Moore at 200 ft at time gets it with Ear only

We now substitute the Bell Microphone
1 Cell battery goes to 54 on 6 box =

Now put dropper at 175 ft.
Hanley goes to 18 on box but only get it once in a while —
Would be better —
This is practically twice as sensitive as Bell Microphone — under listening in condition

We now keep it at 175 ft and add another Cell of battery making 2 cells on phone
Hanley goes to 30 on box

We now move dropper to 200 ft. once in a while get it at 10 on box

2.56 times more sensitive than Bell Microphone notwithstanding increased noise

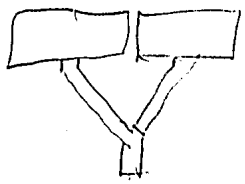
* of course outside noise
masses with additional
battery battering listener.

We now put on 3 cells
* Dropper being 200 ft —
Bell Mears — goes to 14
on box — This is slight
but a gain as with 2 cells
only heard occasionally
whereas with 3 cells heard
it at all times —

We now put 2 Bell Mears
in Multiple arc & use
2 cells — Dropper at
200 ft — Can hear to 12
on box but telemophone is
noisy
The 2 phones at sct in
line facing the Dropper.

We now put the 2 micros in series - 2 cccs Drapper 200 ft - Hear to 14 same as other but its a little more ultrasonic noise -

Each micro so far has its own hole we connect both together by a Y



Phonon Multiple

One aperture,

go to to 18 on Cox-Hanley says clearer

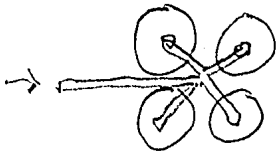
Note

Think 2 phones in multiple halves the roar by doubling the freq vibs thus diminishing amplitude = + a better proportion for ears than 1 phone, the increased quietness also raises sensibility from 10 to 18 on Box - or over 64% increase in sensibility in all three Experiments allowance must be made for constantly varying air noises when wind which greatly interfere with Box test figures -

Think 4 Micro in multiple with 2 cells would eliminate granule movement noises + still be as sensitive of ideal more so than 1 micro, lengths from mouth of input tube & same for all

We took one phone off + disconnected it to see value with present air noises - not using Y plain phone as in first Experiments - Hear to 10 on Box seems to be more roar in with 2 + Y Evidently 2 in multiple + Y is best,

We now put in Moores mico with 1 cell - in place bell micro - Dropper still 200 ft away - Hear to 24 on Box but when it starts to fry only to 10 - Moore had increased weight on lever it fried too much + was so sensitive lost 20 something



July 16. 1918

Moore now is increasing weight on bag still further as its flying again—

Dropped still 200 ft—

Cant be sure heights it — seems as if adding weight it makes it very much more sensitive to outside noises + this prevents us hearing drops.

There is a defect in Moores phone.

He has a very flexible tube at X connecting phone box with outer brass tube

He now will now take off Rubber tube + solder it —

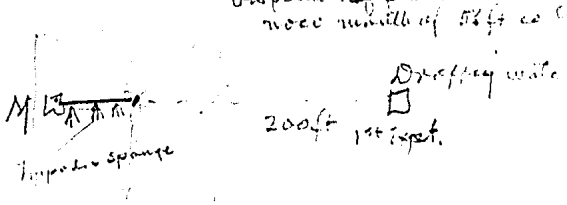
We put back 2 Bell Mers

that 200 ft. heard to 14 oz box
showing conditions not
changed – that I can hear
Moore Heard, with the
~~added wt~~ the extra weight
he has added after the
experiment where he got
24 oz box at 200 ft
Evidently the extra wt
has stopped gun more
but made it less
sensitive,

Bell Magneto & Audion are selective to certain sound differently from Moores Micro & Audion - & Bell different without Audion but Moore Stethoscope —

We now put 56 ft of ½" brass tubing consisting of 3 tubes 14 ft long 1 tube 10 ft long & 1 14 ft long - ~~two~~ 1/32 walls to tubing —

We connected them all together in a straight line by short rubber tubes —



We first listen at M with Stethescope then connect 2 Bell Moores to end of tube by a Y phones in multiple & 2 cells — for Audion

With the 56 ft of tubing
Cant hear the Dropper 200
ft from the Mouth looking down
says its very quiet —
probably friction too much

We now connect the 2
Bell Micros Y connected a-
in Multiple one with 2
Cells of Battery to the 56 ft
Hanley hears to 14 on Box
but not so loud on Zero
of Box — says at Zero
the noise is very much
less than any other
arrangement we have had
says dont hear dropping
steady but comes + goes
says it may be the wind
perhaps drops deflected
by the wind

New Experiment -

Tried some Experiments with Reverberations

Edison with 1" Reverb heard drop 6 ft. by ear 10" by 1 inch - Reverb 36 inches -

~~[illegible]~~ : 63 ft average [illegible]

The 6 ft heard drop by Ear - Hanley heard 14 ft. further, the others 9 & 8 ft -

There is a vast discrepancy between Edison and others with Normal Ear with its Very Sensitive accommodation approaches like the Eye

The ear outside senses & a roar which dampens their

diaphrms so much that it
nearly equals the increase
of Valpuki brought out
by the Reverberator.
Edison if square law is OK
gets drop 12.9 times louder
in 1" Reverb. Whereas
Stanley only gets it 1.5
times louder or 58%

We are now connecting 4 Bell
Micros together for test, 4 way
Connector 1 mouth - 2 cells
audion Water drop rapid
200 ft away.
Its not that I Expect they
will be louder but that

Note

When dropping water on to water in 6 ft in which phone is immersed 24" from surface drop & when faint, sometimes big bubbles are formed when these burst the sound is very loud —

When falling from many holes 6 ft onto wood bottom of a box & all drops seperate there is no spitting sound Edison can't hear but when many drops coalesce & form a gob Edison hear them as spitting in receiver just like I hear on boat

The internal noises due to jars & intermovements of the granules will now be 4 times as many & then cancel each other out. If there is a fry in one phone it will short circuit in the phones that do not fry
In other words it is to stop noises from the phone itself which has the effect of making it more sensitive by preventing "Acoom" in ear to them —

We get 16 on the box
Dropper 200 ft - 2 Cells, no frying or internal noises in phone themselves are heard
We now plug the free end to see if there really is any granule noise or frying

If the bow waves fall over a spray or all drops or white then the sound microphone will be weak but if in addition chunks of water fall each will make an water loud sound + will be cause of spitty surface, discontinuous shower line

drops shower

Spitty

x added on shower

After plugging there is a perfectly clear room quite weak no fry — Can hear it on box to 12 Of course ear is in this condition marvelously sensitive, All garden Experiments with stethoscope + long phone amplifiers very interesting

We now remove long phone receiver + stethoscope tubes + connect Head phones to see how much better they are as they can be used in Cow hair Goath —

All experiments since moving into garden, Stethoscope listening tubes used up to 10 pm — + we find it very poor

With headphones Hear Dropper
to 56 on box - with ~~[illegible]~~
~~[illegible]~~ 4 Bell Mics
Connected to 1 tube,
Audion + 2 cells -
On Sponges as acc action
Experimenter. The noise
is very great on Zero + it's
a wonder Hanley gets
Dropper at all Edison
hears to 15 on box
We then plugged the end
of the tube leading to the
4 Mics but the noise
is just as bad - Edison
thinks sounds from air

like Locomotive jars the
phones as they are on
sponges + there affects
every movement to phones
+ this jars granules —
Edison heavy ~~st~~ train start
+ accelerate on 6 of box
+ its very clear so clear +
sharp that he didn't notice
much the other noises —
Evidently phones must be
rigidly fastened to block of
1 or 200 lbs set up on
sponges so it can't oscillate
Edison also found 1 head
phone so he could hardly hear
in it while the other was
* Very loud 3 or 4 times

Also tonight when Bell was
receiving in garden + Sleitscape

* since found Dolphin bracket
+ touched Magnet

used we got continuous musical sound like an alternating Ckt 6 to 8 on box for Edison, Hanley all thru bldg + yet when we switched over to the 4 micro + used head piece couldn't hear

We had 4 micro on heavy plate + this on opposite sounds Edison 6 to 8 on box — ditto, phones hung from rubber tubes from board 2 ft long E hears to 16 — Held it in hand E hears to 4 — This is best. all these inputs we had input lines to the 4 phones Plugged

yet plugged or not sound
was about same —
When plugged talking
at phone was loud to
Edison then Condon ??
Its the enormous def in Laurence
between Olethorpe that
brought this Bad defect
out —
Tomorrow we tackle
it —

Micros with granules seems to be about worst form for Boats that Roll & Pitch

Some form must be devised that will not move ~~to much~~ by pitching -

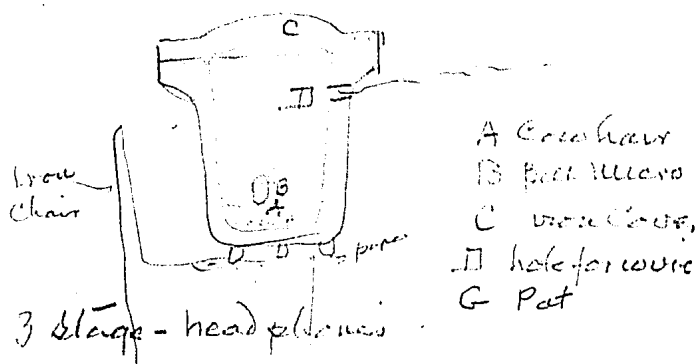
July 17 1918

Experiments to prevent plugged Microfones from being affected by tremors from disturbing it when 3 stage audion is used & most sensitive head phones used

Edison hears noises when mouth of Bell Micro is plugged, which is lost at times at 16 on box & other times 6 on box -

Want to get steady noise down so Edison can hear on box

Hydrogen Annunciating Pot, 6 Bat cells



Wires at D wedged tight to wires by undulations coming wires from mouth phones, 1 One cell.

The noise is awful, slight scratch on Pot keeps heard it many ft away I hear it strong in phone

Talking near it very loud to Edison in phone, although an orifice of phone is closed or its inside closed pot

Edison Coils

Noise goes to 12 for E-
Burns walking sometimes hear
to 8 - but its very clear & dull
good sound. no sharp or spit sounds

Hanley blows puffs of wind Edison
Can not hear at zero,

laying Cord on floor makes
no difference -

Passing fingers over wire cord
very very slight -

When Edison gets 12 Hanley
hits Pot when phone slaps
noise, WE turn it up-over
but its use it wont quiet any
noise Hanley says very
slight but it is now rather

insensitive Edison cannot hear now & then when Bucks Sarah's pat,

We now take Cork out of plugged and no change Something must have gone wrong with Audion as substituting a Bell Magneto & talking right into it Edison hears nothing whereas the sound should have been heard a 100 ft with 3 stage

Bad Contact in a wire tests with Bell Magneto show all right now

* Due to listening phone reciprocally

We put Rec Micro back & in Pat,

* High rate every 4 sec, lots other noise, 1-

With phone plugged hear talking plain — walking on cement floor strong noise faintly — the conversation noise moderate.

Even when E. leaps on his walking table lightly he hears it from far of table from cement floor to pat ultimate to plugged Micro

We now put pat on a board & between board & chair put a sponge

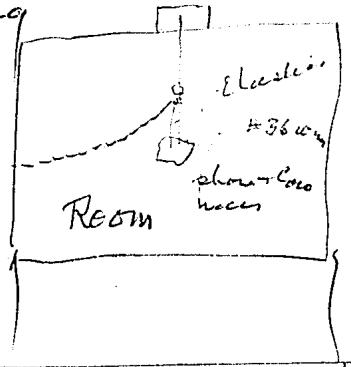
Pat (road) - phone plugged
near Sub station at head
of our way - not only is
jar waves transmitted to
phone but air waves
through wire pat affects
phone even more strongly
the stronger the sound
the stronger we get it,

Mics cant be protected
from air or jar sound by
shielding with Massive
metal [probably the air waves
get thru the hole for wire and]

We now wrap Micro with $1\frac{1}{2}$" Cord hair - PLUG hole + use #36 wire to conduct the ends of which are connected to reg Cord -

The Cord is attached to the pulley + block rope we used for water dripping pail -

The phone ilwdg is suspended from pulley block by 2 rubber Elastics 1/16 sq inch out + 2 ft long



No Cow horn on in this Experiment.
This is an enormous improvement
have high sympathic musical note
comes once in 3 or 4 sec
Tapping table hard breaks it
for a moment on 10 of
Box This note is not but
faintly heard by Edison &
Dont bother — but the
slightest tap by finger nail
on Edison table is very loud
on 10 of Box. Talking &
everything clear,
Great improvement.

OK – There was constantly
Coming now & then high musical
Swiges, it was certainly reciprocation
between the mics & listening
phone then air as I moved
it away 25 ft into Theodora room
and I never got it. Think all
whistling of condition is between
itself & a source of sound which
gives a lag – or 2 sources of sound
one lagging the other when
these are separated. Condition
even 5 stage will not
whistle.
I heard Hayes 25 on 60X
when he was turning Bigger
Sub in lower garage
but neither I or Hanley could hear
it when he was at foot of 1/20 House
stairs too many other sounds

All this may be useless
will know further along

men were also sawing &
splitting wood 275 ft away
& then all other sounds
in neighborhood –

It looks so far that the
smaller the micro the better
Think it can be got in 1/2
Cant say if it should be
light or heavy. it probably cuts
out all waves above 3200 ~~[illegible]~~
~~or~~ not affected by large waves creating
no appreciable pressure shadow

We now take 3/4" micro port
out at Center of Garden
& suspend it & see if it
gets less noisy, also see
how far can get submarine

The small button appears to be not very sensitive Hardly Can hear to 125 ft which is limit of Bell Magneto

Now is small 4 wires it call for Edison — E hears Sub at 50 ft — on Zero box

We now screw the tin diaphragm on button screwed to the mica

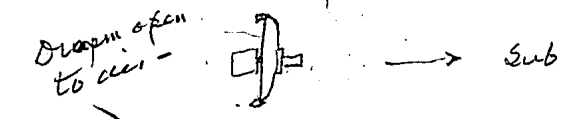
to see if sound ~~shaking~~ makes or what it will do

all suspended as now

Wind, even very gentle moves it & noise in phone band & broken NG –

We now suspend it with two elastics to prevent swinging by wind –– no better

We now suspend a Reg Bell Micro with front Chamber removed to get rid of Chamber Sound – Dia now expanded whole face & connected to Reg back



Suspended by rubber #56 cover for Connection. Same Chamber Cover it to stop wind

think from this a 4 stage
of Extra stage amplifier
5 times that it would
bring Bell Magnetos as sensitive
as this Mecro, + not have
so much noise

Remember 125 ft limit of Bell
Magnetos was obtained by very
weak stethoscope Magnetos + not
present head piece,

Hanley at 200 ft gets sub To
60 on Box – Approx 125 sqn 201
156 Magnetos 200, Mecro

The noise for Edwin is Cut out
at 12 on Box – yet Hanley
hears sub at Mecro this 200 ft

We advance sub To 300 ft.
Hanley gets it sometimes
at 4 on Box – this is
therefore 5 times more
sensitive than Reg Bell
Magnetos but more uncertain
More cheese cloth gives Sub
at 300 ft 8 on Box but
not steady

Apparently small hole + chamber is less sensitive freq than when whole face of dia is exposed, found this true at Key West.

We now hang Bell Magnetic in garden by same stand of suspension as Micro with cheese cloth to test limit of sub with good head piece received against the 125 limit with Oklahoma + Poor Richard —

Hardly only just hear on 2 only occasionally at 150 ft

But when front chamber piece taken off + a ring substituted exposing active surface of Diaphm got it at 150 14 on box

The day being dark Calypso has lights on + I can just hear the AC music-note

Put in Micro with latest suspension, full size of duplex
Exposed Edison Keeps it
plain at price of all models of
8 + Can stick lower at
14 on 60x showing
Micro protected from
jam etc is far better than
Magneto with 3 stroke
PROVIDED it can do
as well on a rolling
pitching ship

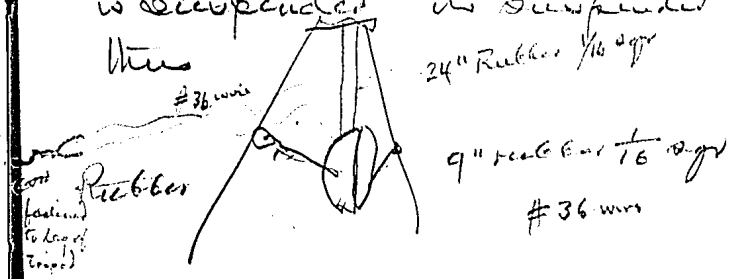
Tonight found it more noisy
than before supper probably
due to less sources, more
sources cancelling out

Hanley Cant hear Sub yet To 300 ft. One call on

Wrapped more cloth over Cheese Cloth – This is black front Cloth finer weave, after ~~that~~ the noise was launched Edwards on box

It started to rain or rather sprinkle can hear it it strikes leafs of Vegitables in Garden cloth not over bottom,

With above conditions we put sponges over legs of Tripod from which phone is suspended. Its suspended thus



Putting sponges under legs NG Edison gets noise at 16 –
awful on Zero – makes whole tripod with cloth around act like a sail & wind even the slightest must jar it & produce the Extra noise —

We remove sponges & Return to previous conditions —

We started the plane swinging its full inversion

about 6@8" & runs for
long time
at each turn it makes a
slight chuck but not
every time, This will be
very slow on a boat
& Hanley thinks it will
not bother at all
We took off the side ~~for~~
rubber guides to try the
pendulum as we are only
listening for support sounds
& not for submarine Bjon

We tried 125 ohm Rec. sounder Induction Coil in Receiving Circuit with idea it might by self inductance wipe out the fine Continuous sounds which sounds exactly like a Continuous soft surface on a device — But inductance not enough - Coil too quick Bunks gone for a large Input or Output induction Closed ring Coil -

We are going to use the ladder that we used for dropping water & get a longer suspension if possible get it twice as long say 4 ft present rubber is 1 ft long untreated & 2' 6" long + with weight phone on

With ladder untreated rubber 1/16 2" 6" & stretched 6 ft. 2 ft off ground

~~Noise~~ Noise worse than before Edison hears to 16 on box - This is no improvement of outside noise with the drum

We now started the expansion
rubber 6" unstrained 12"
checked

July 18 1918

Hanley listening in the
big phono funnel this
morning says considerable
more noise this morning than
last night at 10 p.m.—

1001

This morning we put Bell Micro in Big Iron Hydrogen atmosphere put, put lap on with gasket run wires thru side hole, plugged thes with wax so no air could get in —

The frying was so loud as Even, — One call on Burns talked 5 ft away heard nothing. Then he got within 12 inches talked loud, an intermittent metallic ring was all that could be heard

Proving Most of the noise 90% is constant internal dancing or movement of the

1° finer grain granules
2 Lampblack Coated granules
3 Magnetite granules
4 peroxide Lead granules
5 Sulfide Copper, or Calcopyrite granules
6 Lampblack mixed with tannic of Rose Vine with Extraporia & 6/4 mixed by using Mers alcohol - Dried then pressed in Hydraulic press & dried by heat. Then screened out to my phone wgh.

7 Ditto mixed 200 mesh Iron by hydrogen not self heated - + use magnet 6 & 4 phone

8 Magnesium also Aluminum granules

9 Mix of Bismuth & Antimony granules Equal numbers use no battery make thermo Current

10 - Nickel by H.

Next page

Carbon granules

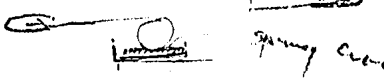
This is the line of Experiment we will take now

We now fill the cup commencing the Mers granules with of ordinary Kerosene Oil to see if Mers Breaking Mers granules wont Clap -

Edison cant hear on Zero of box we now take it out

11

Reg Coil on button. ~~[illegible]~~
between Audiphone & earphone
~~[illegible]~~ to spring tension



12 - Try finest Audiphone
balls instead Cotton

face if it will cut as in
Microphone in air.
Its OK Can hear
Submarine 300 ft
at 4 on the box - best yet
Micro being laid on
Sponges one coil on
Sponges - There is more noise
than in Pot presumably due to air pressure
We need hang it on
elastics & surround with
cloth to get less pounds
noise of pressure

Only 1 coil on these experiments
Suspending dont do any
good Sponges seem to be
best

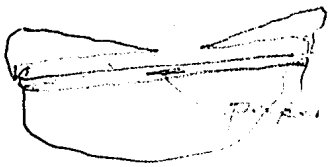
We can get it out of same co.
sponges but noise slightly stronger
to Edison

With 2 cells, noise is only
increased off a little
Hanley hears sub [illegible] away
to 9 on the box but if the
back of head phone is used
it suppresses all the noises
& he hears to 16 on the box

We could hear [illegible]

2 Cells The Milwaukees
flooring is 110 Milwaukees

Hanley puts a piece of paper
between ~~the [illegible]~~ two



diaphrms

on listening headphones
He hears to 30 on box
Sub 300 ft Micro on
sponges. Removing in
granules — [illegible]
We moved to 325 ft
get it to 4 on box
by Hankey

Tried on listening phone 014
020 025 — but none so
good as double diaphm
with paper

Notebook Series -- Notebooks by Edison
Notebook, N-18-07-18.2

This notebook is a continuation of N-18-07-1. It was used by Edison primarily in July-October 1918 in connection with work performed for the U.S. Navy during the World War I. Two additional entries at the end of the book are from February 1920. Many of these notes were probably made at Glenmont, Edison's home in Llewellyn Park, where he was working with James M. Burns, John A. Hanley, William A. Hayes, Sherwood T. (Sam) Moore, and other employees on a series of experiments pertaining to the measurement and detection of sound under water. One entry was made at a lake near Bedminster, New Jersey, with Mina Miller Edison accompanying her husband on the trip. Included are tests with various devices to pick up and amplify simulated submarine noises. Many of the experiments involve microphones constructed with granules of carbon suspended in kerosene or other liquids. Other components employed include brass and rubber tubes, telephone receivers, audions, and many experimental electromotograph (chalk) telephones. One entry describes a series of experiments with water tube resonators. The entries from September and October record a series of experiments with more than seventy different substances tried in electromotographs. The notes from February 1920 form a continuation of these experiments and include a series of experiments with resonators. Inserted into the book are ten loose pages of notes and drawings by Edison pertaining to the same electromotograph experiments. The front cover is marked "No 3." The pages are unnumbered. Approximately 130 pages have been used.

1080 4) 51.8

4) 50.4

12.60

12.95

12.95
12.60
3.5

30 ft 40 c

2 | 1080

12
0

216
1080
1296
0

51.8

250 | 1050

17
0

210
105
0

250 | 1250

1250

1

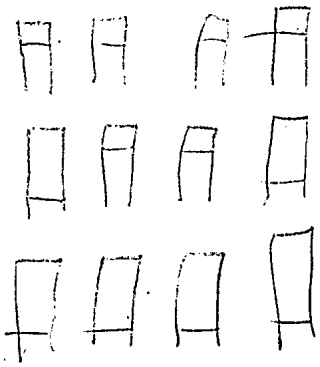
2.25

15.5

256
7
1792

18) 125 (6.9
108
0
172

Adams & Co.,
STATIONERS,
50 JOHN ST.
AND
19 PLATT ST.
NEW YORK.



July 18 1918 –

Continued from Book 2

Experiments with head receiver –
used sand on top of box
no gain –
Used gaskets – no gain –

Best 12 2 Dropping little piece
paper between 300 ft 30 ohm box

We also used stethoscope on this
Head phone & there is no loss
above phone direct against
ear, Either way is OK.

Hanley hears birds sing
phone accurate ft away

We Close the Micro back now + at 325 ft we get it to 4 on box.-

We fill another phone, closed + Reg in Every way - fill with Kerosene this proves more resistance as we get it on box at 6 — when 350 ft away + Cant get it at all on 1st Kero - which is open

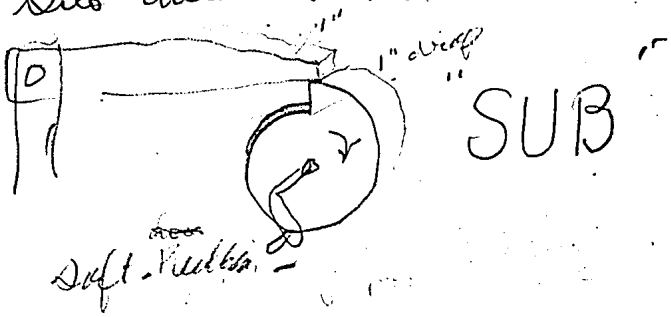
We get it with Closed 1st 2 Kero. 44 on box at 325

No 2 Closed Reg Bell
Mineo - kerosene -
6 of the box is
HIGH WATER MARK
So far ~~or~~ 7.8 times more
sensitive than Bell Magnets.

The noise on No 1 Bro is
8 to E & No 2 is 16 @ 18
No 2 very much noisier
We plugged No 2 myself but
it was just as noisy
showing most of noise
is jar of granules -

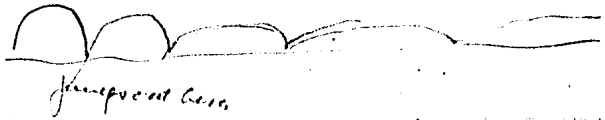
We now adjust No 1 so granule
holder bows closer more to
see how noise changes
While he did it very slight
yet it made No 1 inoperative
So E couldn't get noise

"Sub" imitation in the Cam



Soft Rubber

phonograph of dropping water on Diaphram 2" seems to show that there is only one wave + that the other waves 6 to 8 in number are simply the dying oscillation of the Diaphram



Phonograph trace

of that the Diaphram its echoes from room –

on zero + H we dont get Sub at 300 ft.

These Micros have poor way of adjusting & we get Micrometer adjustment on these we use

Wednesday July 20 1918
2 calls on duty

We now take a 1/2 tube of brass 1/32 wall 4 ft long put Stethoscope at end placed in center of garden with air diaphram at mouth pointing south Burns Twins Sub – Hayes listens to get the limit of hearing 2 30 pm – Sky cloudy only very gentle breeze scarcely any movement of limbs of trees but leaves slightly agitated all over –

Limit 330 ft. under present conditions which is about same as usual –

Notes - Specific Gravity of non Electric Conducting Liquids to be tried in Micro granulator cup -

Heavy Liquids

Acetylene Tetrabromide	2.97
Bromoil	3.34
Bromoform Good	2.88
Carbon Tetra Bromide CBr_4	3.42
" Tetra Iodide	4.32
(Para) Dibromobenzene	2.22
Ethylene bromide	2.19
" Iodide	2.07
Ethylidine Br	2.12
" Iodide	2.87
Hexachlorobenzene C_6Cl_6 solid	2.04
Iodoform solid	4.08
Mercuric Cyanide solid	4.00
Methyl Iodide	2.28
Methylene Br	2.49
" Iodide	3.33
Tetrabromobenzene	3.02
" Ethane	2.97
Boro-wolframate of Cadmium	

See next page

Hanley Confirms this results his limit. They have a quiz-rite pneumatic the general notion -

The above test is with Mica Diaphm in cup same as 17 Hole water phone

Thickness of Diaphm 1½/1000 not specified 1 5/16.

We now take off diaphm & only have the hole ½" dia for air waves to enter

Limit 250 ft Hanley

Harris agree & Beverly also, 2 cells on condition

1.74 times less sensitive than with Diaphm

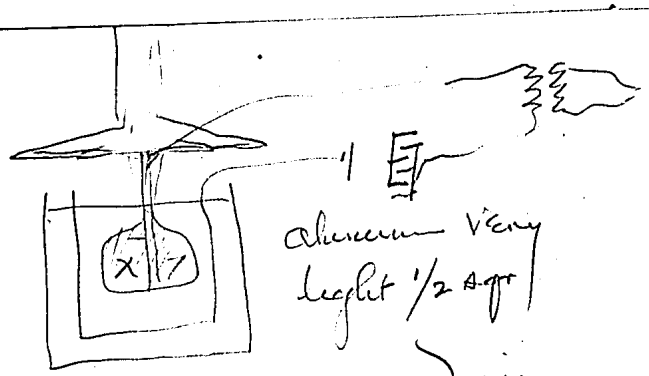
Liquids (Continued) Lighter Liquids

Acetylene tetrachloride	1.58
Methyl Iodide	1.82
Benzene hexachloride	1.87
Benzoyl Bromide	1.57
Benzyl Iodide	1.73
Bromobenzene C_6H_5Br	1.499
Bromoethylene	1.51
Carbon tetrachloride	1.60
" Hexachloride	1.99
Chloral	1.51

In Tetrachloride of Carbon
Bakelite granules from Amer Bell
Phone sent by Friedl,
1/2 floats 1/2 stick Lumpen Cau in
floating particles,
Anthracite granules all sink
Bromoform Both Bakelite
& Anthracite float on Top
Monobromobenzol both Bakelite
& Anthracite sink

All Expts No. 1 2 + 3 book 3 slides

We now put No. 1. Kerosene
Bell & Anthracite granules not used
for 2 days. We now place it
in center of garden on sponges
same as tried it on 18th July
& Plug it to heavy internal
noise — adjustment not
changed — 2 cells on cinders



fixed to dia immersed in Phosphate Soda or least rectifying solution with or without battery X or Condenser or both

Alternating Currents pass from the liquid when p is thrown out of film pore of X aluminum making a vacuum thus lightens the Electrode & is heard when N Comes Water rushes in -

We now use 42 ft of 1/2" 1/32 wall tubing with 1/2/1000 mica on end and in 14ft length test to get distance sound is turned & learn the loss by friction in the longer pipe - = 3 joints - 3 tubes 14 ft each -

Hayes 275
Hanby 275

With & without the Diaphm

This ends direct listening Experiments & gives us all the data we want for the boat apparatus - 1.4 times less sensitive than with only 4 ft with Dia on & 1.7 with it off for some reason 42 ft is better & 1/2 opening or diaphm on its the SAME

*

Note No 1 Receiver has very loud internal noise we noted it on 18th January Receiver leaked out Edison hears to 16 on box Cant hear talking 6" away Except high metallic ring at each word

*

We now start on Expts to diminish internal noises of granules of Carbon in Microphone –

We have put a micrometer adjusting screw with a pointer index so as to adjust the sensitiveness of the phone to known degrees

No 3 is Anthracite carbon used from Jewett July 19 & used partly received,
The granules are immersed in Carbon Tetrachloride,

We adjust sensitive & put into the iron pot plug phone & screw cover down on gasket –

Edison hears to 14 but this is due to very loud snaps at times When not occurring seems to be around 10 @ 12 on box Cant hear Talking

We now adjust in $\frac{1}{1000}$ inch

Edison gets 18 but extra loud snaps gone, only snapy consonants & better — Talking more articulate — grandma was same as came in phone

We now set it $\frac{1}{1000}$ more in making $\frac{2}{1000}$ altogether —

Music just as good 18 & loud snaps -

We now adjust $\frac{2}{1000}$ in more making altogether $\frac{4}{1000}$

big Cracks / Best general as better

Edison gets 14 on already

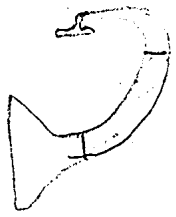
We not set it in .003 more making 007 altogether

No change - less big Cracks

We now adjust in 005 more making .012 $\frac{12}{1000}$

It may be lessening of internal wood is due to deadpening of the movement, only hinge heavier granules & very light liquids wanted by test,

Don't forget line inside base flow with velvet



Kitscraloh Canon

Very little change no bell crackah
Hanley says its pretty tight now so I guess the granules are made too light + are too sensitive,

We make up another phone with 74 Bauxite Gasoline to make granules heavier - even than in Reservoir

Adjusted sensitive — This is much more quiet, has a steady rush very soon, a lip of this is fat fry - Even noise wiped out at 10 for E
Can just hear there is leaking
No cackleckelim on high rate
squeeks very weak Can hear very light
Corner squeek o sheen Scratch sound
after the test tried with dirt burning
Can get 350 ft 30 on box
Cap Hanley -

Best yet while to 28
+ 005 is 32 the
alternating hum here
come in otherwise it would
be at 005 —

We now test the Telephone Cookson 12/1000 adjustable
Hanley gets 350 ft 6 on
box + Sub —

We now set up the Transceiver
005 + (1st adjustment)
and test for sub before
installing in box (plugged)
for internal noises —
Hanley gets 32

We now increase setting up —
005 nets 2 making
010 all together from initial
adjustment — get 28 on box
by Hanley — We now put
back in Potter plug phone —
get alternating note very quiet Edison
leaves it 8 on box

Evidently the lighter the liquid the better as it allows granules to press each other stronger & don't dance so much. The liquid is a sort of a drink pot.

We now set it up one more making 015 which I guess is limit.

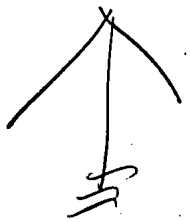
Phenomenon – We put it in pot (plugged) after adjusting to 015 – The alternating hum or whatever it is doubled in strength. + in addition another note perfectly even very much lower in pitch, but couldn't hear any noise at all.

What is the hum?? ???

We now take it out and test for sub + distance. Hanley gets it to 26 on box – Hanley hardly hears hum notes on Zero! The pot seems necessary

So far Anchorage
same as came in the
phones – 74 Bauma
gradient –
Adjusted ~~from~~ 0021
a range of 020 –
Has the least noise
& the most sensitive
+ test yet,

HIGH WATER
MARK.



Specy Metals

Al.	2.583	Thallium	11.85
Sb	6.630	Sn	6.53
As	5.720	Tungsten	18.75
Bi	9.740	" Carbide	16.06
Cd	8.64	Ur	18
C	1.75 to 2.10	Zn	7.142
Graphite	2.10 to 2.585	Zr	4.15
Co	8.718		
Cu	8.910		
Glucinum	1.85 Beryllium		
Iridium	22.4		
Pb	11.34		
Li	0.59		
Mg	1.69		
Hg	13.59		
Mo	8.6		
Ni	8.6		
Os	22.48		
Pt	21.48		
Rh	12		
Si	2.49		
Ag	10.53		
Te	6.015		

July 22 1918

Boiling points & Specy

	Specy	BP
Amylene	.666	36
Butane	600	1
Caoutchene	.650	14.5
Decane (n)	730	173
Di-allyl	690	59.5
Ethylene	687	65
Pentene	700	75@80
Trimethylene	660	21
Heplane	688	98.4
GASOLENE	666@690 (74.3°)	
Heptylene	702 74	98
Hexane	658	69
Isoprene	682	35 to 8
Petroleum Ether	650	70@90
Ethyl Ether	718	34
" Alcohol	793	
Neohexane	649	49.7
Nonane	723	149.7
Nondecane	777	330
Octylene	721	124
Pentane	633	36
Petrol Naphtha	690@700	80@110
Ligroine	730. (23°)	80@120

Sunday July 21 1918

At a lake near Badminster NY
at a Dam, with overflow 3@4 ft wide
possibly 1/4 @ 1/2 thick
falling 1 time

in a gorge = long lake gorge 100 ft wide
Mountains 300 ft high both
sides - trees covered -
Wife heard to 1250 ft could probably
go to 1400, says perfect silence -

We now fix another Micro
with screen adjustment
Using graphite + Backtite granules
sent by Jewett,

First trial very sensitive We
test the aluminate Graphite on
recommendation and get 350 ft
for sub, something wrong
We examine it.

A nut was loose

We get 30 on box by Hawley

To Edison Aluminate Graphite is
about same noise on Zero
but can hear to 16
Backtite Graphite shade less
noise at Zero but only
hear to 10 on box —

We now adjust Backtite Graphite
005 further in —

Note X

The reason we get 34 instead of 30 by setting up making it less sensitive so that the lessened minimal sounds make the ear more sensitive & we hear further notwithstanding the mics is theoretically less sensitive.

X We now get 34 at 350 ft

Edison cant hear beyond 6 on box - Zero very soft, only very few afterthoughts fat fry - BEST YET

We now set it inward 005 more making total inward adjustment 010 -

Hanley get 28 -

Edison cant hear at 6 -

at Zero it is without fat - soft velvet surface

Distances measured by steel tape line —

HIGH WATER
to

This is practically perfect

We now advance the Sub to 375 ft.
Hanley gets 18 on box

We now advance Sub to 400 ft. Hanley gets 4 on box
unmistakeable line of sight

MARK UP
Date
+good Margin of adjustment

On account of insulating ash in idulhracite, the moving of a particle from Contact to a slag section would make a fact fry sound or snap this may be reason Bakelite is best.

It may also be that Bakelite Carbon is heavier than anthracite notwithstanding the ash — also Bakelite is far smoother + absence of very minute points helps smoothness of internal sounds —

Guess real reason is Pot is on ground + gets its tremors where outside phone is on Sponges

Phone inside pot rests on metal of pot.

Phones 2 cells pass about 200 milamp

We now put the Micro in the closed iron pot to measure internal movements of granules

Not so quiet as outside. Micro must have changed adjustment (ie granules moved or some particles got out. Edison can hear to 10 — + Can also hear talking plain — Appears articulate Hanley says it articulate so it may be movements that makes increased noise

Pot is on ground — + naturally gets all its tremors

We now put up the ladder with hose + let the full capacity of hose fall 6ft on top of a wooden box The noise is very great its not continuous but in snaps, irregular + Extremely

Distilled 180 cc of 74 Baume
Grape Cane.
cc 0. Cent Temp
2 38

Sharp & loud by coming
with Sub to within
100 ft Cam head, after
getting used to it Cam
head Sub 200 ft

Edison never heard such
a loud noise from the
water, in Sacramento

This represents it, —
No boat could make 1/5th
of this noise —
Hanley had to
go to 20 on Box

[20]

We now have 3 oz of
Galvalene distilling at
about 95 centigrade
Made by 2 CCC from
74 Be Galvalene —

2 CCC bat
to get it at 200 ft on
account of water too
loud —

With the 2 dynamos —
there is no gain — 20 on box
200 ft.

We now used Nickel reduced by
H, thru 80 mesh on 100 —
put in Micro box in
galvalene, 1 CCC battery
+ 50 Ohms of Rev in
Circuit, to see if worth at
all —
Can't get anything

over

We now crush some of the Bakelite Carbon thru 160 or 180 — but there is some wood splints from screw holder in it which may hurt it — We make up a Ullard cooling Gravity 2 cells on —

at 400 ft 4 on box

Edison hears only to 6 ~~[illegible]~~ rather quiet at Zero for E.

We need set it up 005.

Hanley says same as other to wit 400 ft. 4 on ~~6 box~~

Even if on 180 mesh is as good as the size used by Bill Co is an improvement it is more quiet

If it dont pack after phonograph plays close to say 3 ft for 6 hours it will be OK –

Edison cant hear on 4 – at 2 its weak + zero very little more – By fare best yet for Edison –

NOTE

If no packing takes place Bondite Carbon Item 160 on 180, + probably in Petroleum Ether 50 Cent B Point – 112 Fahr will be the best,

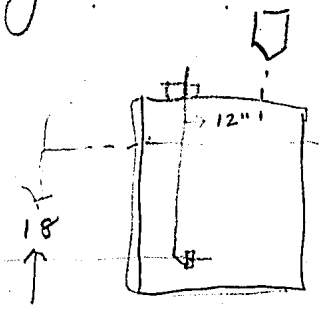
We now Quit Experimenting

with Wires until I get
a supply of Conductive Carbon
to make various grades of
sizes + also loaded with
substance to increase weight
of Carbon granules

We now fix the barrel of
water & Can to test
Reg 1:6 hole mica water
Receiver against
Torsion leverage double
dampen to amplify

Just made by Moore

Pipe on Sponges



1/2" pipe

8 ft brass pipe
6" piece rubber hose
connecting pieces

Using Bell Magneto at 3 volts

Hanley 50 -
Hayes 46 -

We now put in the 2 diaphm
amplifier made by Moore

Hanley 40
Hayes 40

This is very favorable
as the apparatus is not
made properly. well

fix it & test again

July 24 1918

Tried experiments with EMG using Strontium Carbonate 21% KOH.

With Bell Magneto connected to Cylinder phono by 6" rubber tube 3 oz. Large Audion, Handpiece 1500 ohms in CKT I heard to 30 on 60x. Whereas listening to Bell phone as Receiver only heard to 18 on 60x –

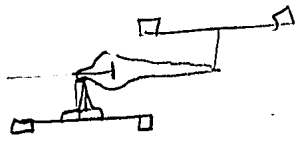
Have small mica phono Reader old style Cup. – Mica Dia 15/1000 –

Oth made a Galah by removing worm + pulling in 3 gears well removes with the morning + put back worm drive

Using stethoscope tube
Cant hear any scratch at
all on horn
Hayes says he only hears
groans.
This looks very promising
for a submarine detector
Can get it reliable - IF

Kisselgur - 15000 ohms
in check ckt heat to 16 on
box - it starts to squeak
when pressure too
much by more KOH
got to 22 on box
but tendency
squeak -
see further on

Moore has fix the lever on 2 diaphm Multiplied so its on a dead line



Hanley gets 60 on boxes
Water drops 6" & hits
water in BGL condition
being same as the previous
test. with the other lever
With Reg waterphone (17
hole) get 60 on box
We now lower the
drop so water only
drops 4 inches

instead of 6, to get back on boxes –

Hanley gets 30
Hayes " 28 out of

We now put Moores model in – water dropping 3"

Hanley 44
Hayes 44

Showing Amplification is going to be a success

Tungstate Calcium Enf—
Takes lots 20% Even
works when wet
with Kott, but got
to 18 @ 20 on 60X
Crumpled — Too soft
must be harder or a
binder — Its promising
This is rejected
Phone, Bell phone Magnido
6" Rub Tube, 15000
Ohms Res

China Clay
Cant get a sound
probably because leaflets
+ no prints —

Rotten Stone
Not a sound

I put in the old Chalk $SrCO_3$
I had made last night
without (setting
got 16 although dried
all night = Wet at touch
Rot. got 36 on box
13 used ones in

Strontium Oxide
Very poor, Crumbles
~~Shows~~ 4 on 60% -
pulls out when wet

Lithium Phosphate
softens up on wetting
poor volume

Bismuth Oxide
Takes Enormous
amount of KOH
poor, Phenomenon

it works at times with
scarcely any pressure
while not at all
with usual pressure
Its white but see
why it is which
except its oxychloride -

Uranah Soda Hydrate
Unlimited in taking
KOH, too cal-
phenomenon is only
works when put balls
KOH on one side but
Chalk holder one side
only something strong

Cadmium Oxide

Very poor, scarcely a round -

Magnesium Silicate, got in illy by Commission found Making -

Cant get a round

track blackens, pbly

Cuts Plain

X This is 8 1/4 % better than Regular

⊗ This is 28.2 % better than old 16 hole Regular

Tests for accuracy of different Water phones

July 29 1918

Reg 1 1/2/1000 - 16 hole - water drop 4" in 6 hrs -

Hanley 28
Hayes - 28 on box

Hayes made another with 3 Holes 002 Mica - Dia 1/2"

X Hanley 32
Hayes 36

No 3 Hayes Complefying with Center button on dia giving 5/16 cent - price drop

⊗ Hanley 40
Hayes 38

3/32 around edge of Dia

(362)

tests of Water phones
July 30 1918

Reg 1½/1000 16 hole
Water drop 4" in 66 ft. Bell
Magnets on 2nd ½" tube
10 ft long 3 large cell
Moore 40
Hayes 40

3 Dia hole 002 mica Dia ½"
Moore 42
Hayes 44

Moore Amplifier
Moore 42
Hayes 42
Center button ¼"

July 31, 1918

Same tests over again after Moore hardened & fixed up — he used 1/4" center pieces on the 3 samples

Req 1½/1000 16 holes 4" Strip of water —

Moore 40
Hayes 40

3 Holes 002 mica ½ dia

Moore 45
Hayes 50

Moore Amplifier 1/4" center balls 002 mica — Re-assembled

Moore 40
Hayes 40

Made 3/4" dia 5 holes 1/4" dia
1 1/2/100 mica Drop water 4'
wet test -

Moore 42
Hayes 40

Moore again - bit Mica
005

Moore 44
Hayes 46

Moore again 009 1/2

Moore 42
Hayes 46

Note

July 31 1918

Chalk phone —

W Va Limestone Dontwork

Lithograph stone Nothing

Native Silicate Magnesia (?) Nothing

Aluminum Hydroxide

Very smooth, it cracks when wet, but works ok

Several cracks due to shrinkage Limit

30 on 60x Band

Music 3 stage Bell

phone connected to

phone by 6" Rubber

tube 15 ohm 3 stage Amp

This is very promising & several should be made to try deformed strengths KOH NaOH, Li & other solutions —
Could mix the $AlOH_3$ with Stronalia only Light pressure required
Great Merit is Smoothness

The Chalks Could be wet with KOH before moulding

Lithopone, only 6 @ 8 on box —

Tungstic acid. KOH
attacks it 4@6 on box
which it turns
Can only use ~~[illegible]~~ with
acid + other solutions.

Strontium Oxide -
account 16 on box
takes only little
KOH, -

Tried the old Rhodia
been cost 3 or 4 days
Report but only 16 on
box

Aug 2 1918

Magnesium Ammonium Phosphate Baked Moist with slight amount KOH to neutralize

Got 8 on box flakes —

Sodium Antimonyate Not a Dozen

Barium Antimonate takes unlimited KOH at times strong goes bad then wet stages then hard acens and of a coral pelargin of platinic oxides at times 10 on box

Queer?

Silica - softened with KOH, then baked

12 on box

a quick with heavy press

Fe_2O_3 from igniting
Oxalate. - Baked
8 on box - bad surface
tends to squeek on
heavier pressures

Blank Fix
$BaSO_4$ -
7 or 6 x squeeks
Cracks -

Note

Aluminum hydroxide - powdered
heated at 212 before
moulding its load but
cracked in two before
could recover -

Aluminum hydrox no
water - no KOH.
Baked 5 hours at
212 - pressed 500 alm
Cracked but accurate

Al Hydrox no water
no KOH. not baked
500 almos Dont Crack
20 on box unbroken
Try LiOH KOH various strengths
NaOH - 500

Mixture Alumina Hydrate
& Strontia Carb.
Equal parts by
weight — not dried —
12 oz box

Cylinder turned
from Potash alum
No round.

Aug 5 1918

Nickel Oxide from roasting
Oxalate moist with
Sodium Silicate
Baked
Rough bad -
8 on box bad
irregular - squeak

*ferric hydroxide —
Cant get a sound

Calcium Hydroxide
8 on box
takes up lots
KOH — over track

Aluminum Hydroxide prepared into
cylinder 500 cc using no
water or KOH, then heated
212° for 3 hours then heated
300 @ 350 1 hour — Cylinder
cracked, powdered it +
again placed 500 cc no water
or KOH - 26 @ 28 on
box —

Moore amplifier
all knife 2 stages –

3 holes 002 Reg – 1/2 – dia
Moore gil 4
Hayes 50

Moore 002 – 5/16 including
1/2 –
Moore 42 –
Hayes 42

Not yet it yet

Cadmium Hydroxide.
Just hear on Zero -

Lead hydroxide
(Can't hear a sound)

Mercuric hydroxide
Its weak on Zero yet
hear to 12,
Phenomenon lightning
the precedence the decrease
it is — an explosion
all others —

Tes Lucelick dont

Good

Bismuth hydroxide
Has peculiarity I have
noticed in others
Will hold only when
scales are wet through
paraffin probably
Insoluble = get too
much KOH -
Try others.

Magnesium hydrox
30 on box good
probably 32 -
Wont stand much
KOH - if too much get
soft -

Zinc hydroxide
26 on 60x –
Wont take excess KOH
softens –

Stannous hydroxide
No sound
Cylinder softens
With Dry [illegible]

Aug 7 1918

All swells up 11 9
no sound

Cupric hydroxide
Not a Round

Cobaltic Hydrox
probably 4 to 6 on
Cox-plan —
Busted

[54]

Ferrate of Barium
Decomposed a sound
only at times

Manganese hydroxide
Mg
Nickel

Carb Strontia
LOEt with NaCarb
only 10 on box
added KOH, only
12 on box

Carb Shooting
1st wet Arsenite dado
only 4 @ 6 on box
afterwards KCN
only 10 on box

Carb Shooting
wet with 500 Silicate
Dilu + 45 cc Water
only 4 to 6. wet
with some KCN
get 8 @ 10-

Carb Strontia
Sodium Monosulphide
8 on box – when
wet KOH! 16 on box

Carb Strontia
Sodium Hyposulphite –
8 on box – after
KOH, 16

Carbonate Strontia
KCN – poi –
after KOH
30 on box

Carbonate Strontia
Sodium Borate,
8 @ 10 —
after KOH 28 —

Carb Strontia
Sodium Peroxide
Sat Sol —
4 on box to the
KOH 28 on box

Carbonate KOH
w Borax —

Now test with
Mg hydroxide
" } with
$SrCO_3$

def percents of KOH
NaOH, LiOH,
Caustic OH, + let the
test all round

	on Box	
Kissolghur	22-	
Carb Strontia	30	
Ca Tungstate	15	
Strontium oxide	16	Crumble
Aluminum Hydroxide	30	
Mg NH4 phosphate	8	
Silica Potassa	10	
Fe_2O_3 "	8	
Magnesium Hydroxy	30	
Ca Hydroxy	8	
Mercuric Hydroxy	12-	Can use V bright pa
Zn Hydroxide	26	Explosive

Carb Strontia
KOH only -
Don't [illegible] 12
Don't [illegible]
this -

We again resume expts with Osmion - Sept 13 1918

3 stage, Bell p 1300 [illegible]

Test phone gives 16 on box

---

1 Magnesium hydrox made by Eckman Bell 16 28 on box

---

2 Magnesium Sulphite No sound. dont take up but little KOH, then pull out —

---

3 Chromic Hydroxide appears fair but crumbles Cant get test If made with KOH & then wash chalk with water might do

CGOI

4 Magnesium Phosphate
Bell 16 — This only 12 on box

5 Magnesium Oxalate,
on 4 — Neg
should be made with KOH softener not
with Carbon

6 Magnesium Hydrox (No 2)
only 20 — dont take up
but little KOH, shows
tendency to flake

7 Magnesium Citrate.
12 on box — softens
bad but by letting soak &
dry a little got 12

8. Magnesium Acetate
dissolves No Sound

9 Nickel Ammonium Sulfate –
Dal No Sound –
KOH Dont go in –

10 Copper Carbonate
seems work good absorbs
KOH OK – good track
NO Sound Bellquasi 6

11 Litharge –
works good, takes up large
quantity KOH, track OK
Not a sound

12 Lead phosphate
hardly hear anything
Bell 16 - works good otherwise

13 Calcium ferrocyanide
takes up considerable KOH
get 28 on box!
Bell 16 -

14 Red Oxide Mercury
works ok get 22
on box

15 Lead Sulphate
Bad cylinder but
works ok no sound
Bell 16

16 Colloidal Fe_2O_3
Mucks all up
No sound - Fred said
it turned like a metal
in long chips ? ?

17 Iron by H.
just heard it - Scratches
also lead - squeek

18 Barium Hydroxide
2 on box

19 Light Calcined
Magnesia
26 on box

20. Magnesium fluoride
30 on box.
its very strong to 24
then falls Loose
Smooth Notice
& Cracked Colour KOH
put on way across

21 Calcium Citrate
Softens up tears

22 Zinc Oxide -
12 on box

23 Calcium Sulphide
6 - greedy of KOH

24 = Strontium Salicylate,
Decalcifying Bone take
KH.

25 Sprue Berate,
takes up only little port
quess 8 on box

26 Strontium Oxalate.
38 on box
Bell 14 mixing
Crack (1e) shrinks but
keeps hard,
Expect with this.
Mould + soak in KOH before
turning off + stop crack,

27 Magnesium Carbonate
12 on box

28 Barium Phosphate
10 on box

29 Calcium Arsenate
26 on box
Crucible Cover not
left — Exact
Very low on
shelf (No box)

30 Calcium Oxalate
32 on box
Very low on shelf

31 = Calcium Sulphate
2 oz box Cont
Take KOH but little

32 Chromate of Calcium
20 oz box

33 Zinc Carbonate
Nothing
20 oz Bottle —
Don't use only
Trace KOH.

34 Calcium Iodate
Powders Dried

35. Lead Nitrate
Dunham, NY

36 Potassium Permanganate
Squeeze 10 on box
Unseen around top

37. Strontium Sulphate
4 – [illegible]
[illegible] to squeeze

38 Manganese Dioxide
Dunham

39 Ferrous Phosphate
14 on box

40 — Magnesium Borate
8 to 10 dollars
up 100 pounds.

41 — Black Antimony Oxide
April 16 1918
Bdl 16 = 28 @ 50 on
box. it cracked some but
ok

42 Strontium Peroxide
28 on box

43 Aluminum Hydroxide
24 = Chemical Sponge
in Crocks 2 Cases
Crocks — handles

[10]

44 [illegible] Carbonate
[illegible] 2 [illegible]
powders [illegible]

45 [illegible]

[illegible] - [illegible]
[illegible] -
[illegible]

47 [illegible]
[illegible]

48 - Barium Borate.
14 -

49 - Copper oxide.
Ball 20 - not very loud on Zero but goes to
32 on box
Aint improves much by heavy pressure
works on light pressure.

50 - Magnesium formate
12 on box

51 Magnesium Ethylsulphate
Dissolves

52 Calcium ~~Silicate~~ Silicate 55
34 - Very loud at Zero -
Takes Enormous KOH. takes 5 or 6 times 1 cc - also it works at first while Mercurial lost.
After activation with KOH + 10 pounds of track goes 20 on box

53. Blackoxide Manganese
Bell 18 Rough —
No Sound

54 Manganese Carbonate
Rough No Sound

55 Lead Peroxide
Rough No Sound

56 - Iron Sulphide
Rough No Sound

57 Barium Arsenate
Bell 18 — 8 — only take
a little KOH —

58 Zinc Sulphate
Barely near on
Zero of Box

59 - Strontium Ammoniate
20 on Box

60 — Strontium Arsenate
20 acts
Quiet gets loud then
gradually weak +
music sounds like it
was jumped out

61 – Manganese Borate
14 – Dont take
hardly any KOH

62 = Nickel Citrate
Dol NG

63 Cobalt Sulphate
Soluable

64 Calcium Silicate
30 @ 3Z Dup
Odd quer. slope
then that again as
OR – Dquick note
apparently fm phono

After 1/2 hours
[illegible]
Looked worthless

65 Iron Carb ?
~~Just [illegible]~~
~~No Sound~~
2.60x

66 Nickel Oxalate
No Sound

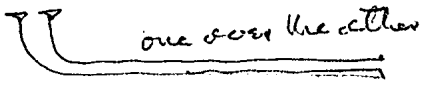
67 Lithm Carbonate

68 Retrial
Nickel Oxalate
Cracked NG

Sept 17 - 1918

* Little Sub Knocker used before

Experiment with 2 brass tubes ½" inside 50 ft long - with holding cup for water phone but no perforated plate or diaphram



Hayes hears Sub thru air -

When listening with stethoscope Each tube separately gets limit at 220 ft -

When listening with a single Separate tube to each ear from each brass tube hears it at 360 ft.

The squares of these distances of stethoscopes 2 tubes 2.7 times more sensitive than a single tube

Its 68% more distance allowing for loss of sensitiveness of diaphrams hence if we heard boats at 700 yards then with double tube we should hear them equally as well at 1150 yards -

67 Lithium Carb all day
Bell 18 lost weight H_2O got 6 or 8
on box ?

69 = Benzidine Sulphate
No Sound

70 = Amidophenol
No Sound
Don't take KOH.

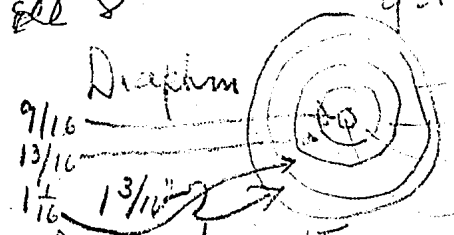
71 Anthracene (CP)
No Sound
Don't take KOH

72 = Amidophenol Hydrochloride
No Sound

73 Naphthalene
No Sound

Oct 3rd
Bell 9 - Edison has cold
Carb Shoulea 18

Bell 8 got 28



Much better as
it allows more fraction
of pressure

Bell 8 — get 28
Carb Strontia new dia —
020 —
When the other Check
plume in series.
get 24 on box —
Zero in Multiple
get. 26 — not
much diff.

new Dia 020 Ct 4 500 at
Calcium Oxalate
Bell 12 —
Edinburgh — 30 on box —
Cracked Longitudinal

500 at
Bell 12 — Strontia Oxalate
30 —

020 diaphragm
Calcium Delicate
Bell 12 26 500 at

Copper Oxalate
28 —
Has more density than
the others — 750 at times
Volume poor on Zero

Strontia Carb (500 at) Trial
40 hours ago removed + put
in general Bottle, bottom working
Carb here to 6 on box —
Wet a little get 30 @ 32 on
box

Bell 12

Oct 8 1918
Oxalate Shrouded -

Bell 12 — 32 -
Acoustic gas Bred. - 750 atmos

Single 7/16 tubes 50 ft long
Pdg Haynes water cooling

001	Mica	heavy Sub	300
0015	"	"	300
002	"	"	300
003	"	"	280
004			260
005	"	"	235
006	"	"	210
007			—
008			—
009			190

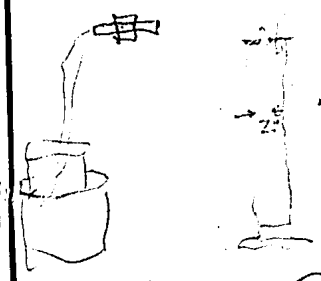
with 2 tubes 7/16 internal Dia -
0025 (2 3/4 long) heard 500 ft -

Oct 29 1918

Experiments with Water Tube Resonators 2" dia 1000 cc glass -

Using Middle C small Tuning whistle 2" long 3/8 dia with Reed - ~~Blown by~~ by cash Coin gas chamber -

The whistle has Column in Resonator No 1 15 1/2" air column & No 2 15 9/16 Column



Were not Tuned Exactly
flowing to 6 1/2" from whistle through listening tube, beat

volume ~~[illegible]~~ resonator ~~[illegible]~~ to
Tuned to fundamental 15 1/2"
E heard to 21" away

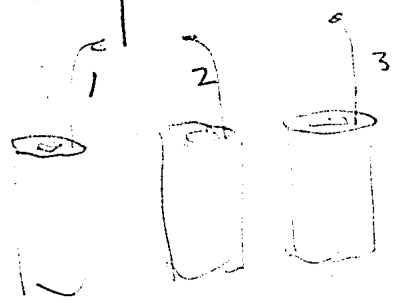
C701 D

Thus by the square law makes amplification 12 times

Put the two Resonators off 150 ft from C Hayes says much louder these tubes than direct also intermitting whistle makes it more conspicuous also that Simpson running fore 75 ft away on lawn circuit around that the noise of auto was very much cut down by tubes, only 1/3 of what is w/ by direct Ear —

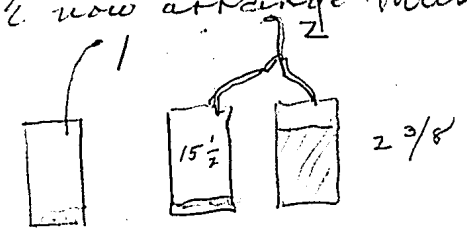
We are bothered very much by wind blowing across Resonator half sounding its note, & will surround it with a tent open at the top to see if we can stop it — This is OK

While the fundamental is 15 1/2". The only other sound is at 2 3/8, which is a 7th =



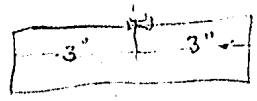
1 & 2 are fundamental notes 15 1/2"
No. 3 is 2 3/8 as column —
~~No.~~ 1 & 2 are louder when listening in their tubes than 2 & 3 —

We now arrange thus



and find on listening to 1 & then to 2 that 2 is louder & outside noises & sounds audible around is less than in 1 — The quality is fuller & more like the original ym and quality & loudness

We had a battery jar 6" diam 11" deep but closed not found any tone not deep enough for fundamental & too wide for ym.



2 3/8 — under these conditions impossible to get 2 3/8

Were the jar 16" or 18" the fundamental 15 1/2 would probably be louder than with 2" CC was

We now have 4 more glass jars 2 tuned to fundamental of C & 2 to ym —

150 ft away uncertain which

is the loudest fundamentals pinched off or ~~the~~ pinched off all on, all on seems to be loudest, 150 ft to close

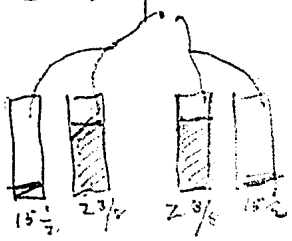
We now move the tent & Rasmussen a long distance, 775 ft ~~[illegible]~~ or 150 ft about beyond hearing direct with ear. Ras put in tent to keep wind from blowing across mouth of Ras & mouthing Coleman cornet

These experiments so far show the utter improbability of a man with good ears detecting delicate changes Even big changes in the Volume of sound. The only way is to find the limits of audibility for each change

406

~~Yesterday~~ we heard ~~550~~ ft direct by ear ~~[illegible]~~

With fundamental 15 1/2 & overtone tube 2 3/8 @ 2 1/2 for one listening tube



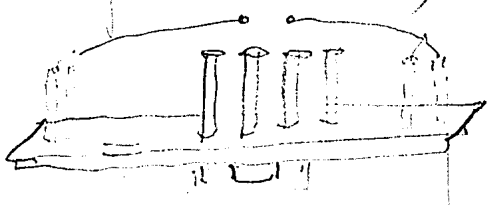
We hear plenty a distance of 775 ft - Even when the ford is 25 ft from listening tent and on line now, We admit the C tube - Hayes thinks he dont hear ford on tubes but Hum has heard earlier

When Recumbent & Y were talking 150 ft from C Coleman Hayes heard whistle - & says he could hear

still farther, this is at least 250 ft beyond the limits of hearing by Ear direct.

After we reach the limit of audibility - take jars to C & time for open end tube & try -

Make turn table to put the 4 jars on to get best direction,



4 ft

Make a brass tube say 6" dia & 32" long for fundamental -
Think we have one jerry made up in Garage.

Oct 30 tests today - moved tent across glen - Distance now 1090 ft - Good to about limit. Day rather quiet some wind but more noisy than yesterday - We estimated sound 1 1/2 per second so we make it far more easy to recognize amidst the other continuous sound.
On Return I find the 4 Res are not so sensitive as I thought ~~about~~ fundamental not as strong as 4th - both together don't seem any louder except at times. This may be due to difference in blowing as the overtones increase in Volumes more than fundamental when harder blowing

(82)

I put 2 Rec both tuned to 7th
+ found 2 in unison
Very much louder than one
alone —
I then put 4 tubes all tuned
to 7th by [illegible] were
in [illegible] [illegible]
greater complication [illegible]
of listening tubes I heard it
untouchable 31 miles
The best [illegible] 20
miles —

This is a point,

This should give 1635 ft instead of 1090

Proposed new ones
~~Strontium~~ Silicate,
Aluminum "
Magnesium "
Barium
Zinc
Cu. Fe, Mn, Tin,

Aluminate Calcium
" Strontium
Barium
Iron
Zinc
Tin
Cadmium
Copper

Arsenate Calcium
Magnesia
Zinc
~~Strontia~~
~~Barium~~
Tin
Cadmium
Copper

S

Recapitulation to this point

	Oxbox
Kieselguhr	16
Tungstic Calcium	20
China Clay	0
Rotten stone	0
I Strontium Oxide	4
Lithium Phosphate	poor
Bismuth Oxide	Poor
Uranate Soda	poor
Cadmium Ox	poor
Magnesia Silicate (Native)	0
W Va Limestone	0
Silicate Magnesia (Native)	0
Aluminum Hydrox (mix of alids not hydrox)	+ 30 +
Lithopone	6
Tungstic Acid	5
Z = Strontium Oxide	16
Magnesia Ammon Phosphate	8
Sodium Antimoniate	0
Barium "	10
Silica	12
Ferric Oxide, (ignited Oxalate)	8
Blanc Fix	2

Slip Al hydrox $SrCO_3$	12
Cylinder turned from K Alum	0
Nickel Ox (ignited Ni oxalate)	8
Ferric Hydroxide	0
Calcium Hydroxide	8
Cadmium Hydrox	1/2
Lead Hydrox	0
Mercuric Hydrox	12
Magnesium Hydrox.	+ 30 +
Zinc Hydrox	+ 26 +
Stannous Hydrox	0
Cupric Hydrox	0
Cobaltic Hydrox	5
Ferrate Barium	0
Manganic Hydrox	0
Magnesium Sulphite	0
Chromic Hydrox	— Crumbles
Magnesia Phosphate	12
Magnesia Oxalate	4
Magnesia Citrate	12
Magnesia Acetate	0
Copper Carb	0
Litharge	0

Lead Phos	0
Calcium Ferrocyanide	+ 28 +
Red Oxide Mercury	+ 22 +
Lead Sulphate	0
Colloidal Ferric Hydrox	0
Iron by Hydrogen	0
Barium Hydrox	2
Light Calcined Magnesia	+ 26 +
Magnesia Fluoride	+ 30 +
Calcium Citrate	Crumbles
Zinc oxide	12
Calcium Sulphide	6
Strontia Salicylate	dissolves
Ferric Borate	8
Strontium Oxalate	— 38 —
Magnesia Carb	12
Barium Phos	16
Calcium Arsenate	+ 26 +
Calcium Oxalate	+ 32 +
Calcium Sulphate	2
Calcium Chromate	20
Zinc Carb	0
Strontia Fluoride	10
Strontia Sulphate	4
Ferrous Phos	14

Magnesium Borate	9
Black Stannous Oxide	+ 28-30 +
Strontia Borate	+ 28 +
Alumina Chromate	+ 24 +
Bismuth Sub Carb	2
Ferric Oxalate	0
Bismuth Oxychloride	0
Zinc Oxalate	8
Barium Borate	14
Copper Oxide	+ 32 +
Magnesia Formate	12
Calcium Silicate	+ 34 +
Peroxide Manganese	0
Mangan Carb	0
Lead Peroxide	0
Iron Sulphide	0
Barium Arsenate	8
Strontia Antimonate	20
Strontia Arsenate	20
Mangan Borate	14
Nickel Ox	0
Lithia Carb	6
Benzidene Sulfate	0
Amidophenol-p-	0
Anthracene	0

Amidophenol. Hydrochloride 0
Naphthalene 0

Feby 12 1920

Having made a large supply of the best cylinders I start again Experiment on Chalk phone

1st Thing found out that the Cotton fibre brush we use for washing the Cylinder makes a Colloid by action of the Alkali This caused colloid to remain on surface while KOH goes in and we are always working on the Colloid and not the mouth of the pores of the Chemical

We then cut a piece of fine pore Rubber Sponge and used that instead but we should have heated it in 20% KOH to get excess sulpher & other impurities out,

The 3rd thing I found that our pens with Palladium plate resting on Top of Cylinder & pressure rubber never

Cooperate except by chance to get loudest reproduction —

for instance with a light Calcium Oxide of Magnesia & got nothing whereas on removing pressure rubber & having finger for pressure, got it quite loud but had to press one side & not direct down —

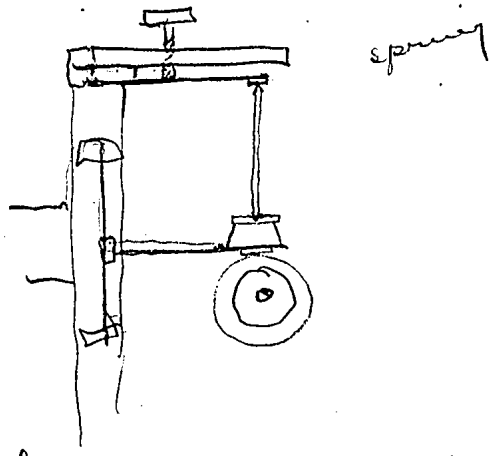
We are making an Universal joint pen to see if it will always fit & direct down pressure give even results.

Another thing I inadvertently have been using 20% NaOH instead of 20% KOH.

Feby 16 1920

The Universal joint NG —

put old wide 3/16 pen back & changed Ulius



This is best yet, got with Carb strontia 12 on box

Think can enormously improve this keeping $SrCO_3$.

When the pen mechanism is OK think can get 20 possibly 30. As far from the right device to get full efficiency

30
30
900

900) 2743 (3.04
2700
43 00

5225
5225
26125
10450
26125
27431 25

4) 1090
272

1090
816
190 6

36

600625

164836

164836) 600625 (3,6
494508
106117

165000) 1000000 (6.
990000
10000

3396720

21
21
21
42
441
36) 36 (1
87
9

3) 3470.
1733
25
5665
2266
2832 5

8-to much-

20
8
60

1/2-

775
406
369

2/1090
545
1635

4—16
16

164000 | 1.188100
1148000
000 | 7.2

1890
1090
9810
1090
1.1881 0 0

775
775
3875
5425
5425
6025

1.188100
1148000
401.000

406
406
2436
1624
1648 36
369.00

[ITEMS(S) FOUND IN BOOK]

Cant hear Bell.

Reg Stronalin 8 — 750 ohms
Reg Stronalin 8 strong 1000 ohms
but tendency to squeak

Calcium Silicate 6 - 1000
not quite up to 6 -

Calcium Oxalate 7+8 1000
think this is more even
Volume than above
but squeaky takes lots
sodi —

Strontium Oxalate Zero hear 1000
Little Rattler Chain when only little Mg

D. Ithacene CP Nothing 500

[ITEMS(S) FOUND IN BOOK]

(2)

We now chang width of
pallidum from 3/16 to
[illegible] 1/16 -
fend it - precocacy
2 on 60 x hrs later -

Light Centaurea
Magnesia just heavy 4 300 ~~CH~~
Breath doesn't seem any tracheal
flow - cough of Bicht

Light Calcarea Mg 6 to 7 600 ~~CH~~
Smooth - Very -
takes KOH 20% Very slow 3 days.
take 2 or 3 min to slow

Light C Mg 6 slightly 800
New York

[ITEMS(S) FOUND IN BOOK]

Light Calcined Mg 4 1200 ct
700 pressure Great for this

Oxalate Zinc 4 — 800

Cobalt Oxalate, Nothing 800
Boutreak in decomposes to
Blue hydrox —

Manganese Oxalate MC
Decomposes —

Copper Oxalate X 800
Boutreak to decomp — it could
not take KOH —
boutreak in —

(1)

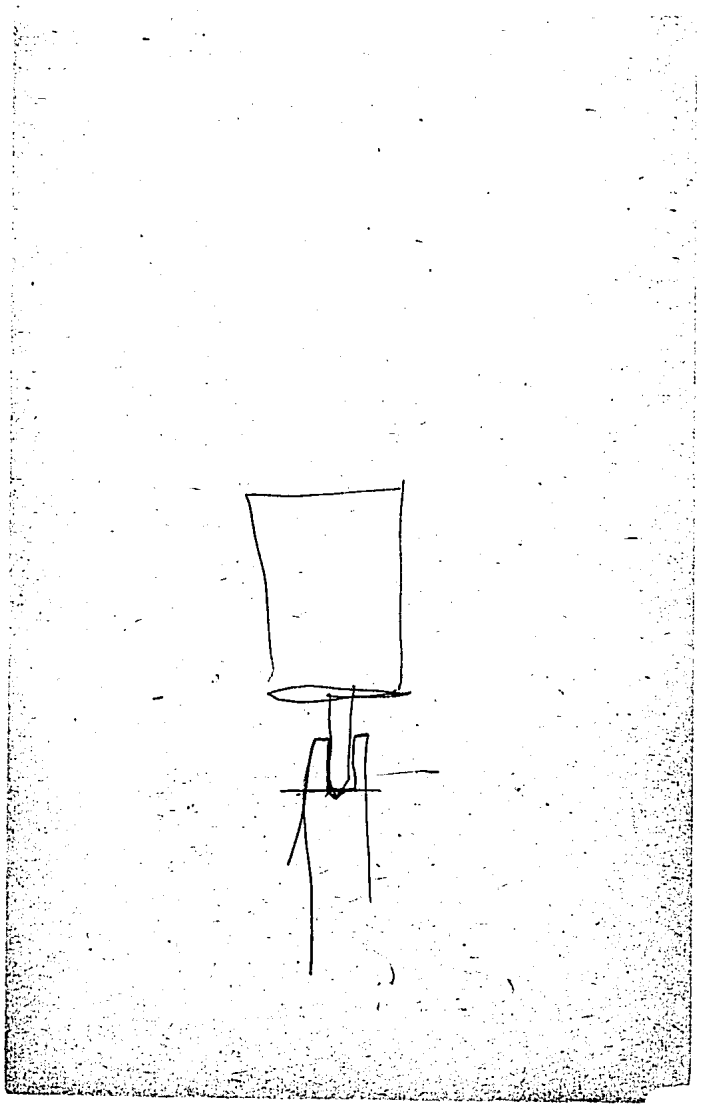
[ITEMS(S) FOUND IN BOOK]

Stannous Oxalate X 800
don't soak in —

Reg Stroulia substituted
a 2200 ohm Bell for
Reg 100 ohm bell for
Random don't improve
it very much I think
its reasonable to 2200
cos I get to 10 on box
probably because
high voltage —
Think will make
this standard

(42)

[ITEMS(S) FOUND IN BOOK]



[ITEMS(S) FOUND IN BOOK]

I will now put in a standard Stew Stronta
tree beet Can do —
2200 ohm Sender Bell —
I get 10 on box
the very limit but only
at times hear it

Oxalate Calcium 1000
lbs ——
2200 Res Bell Sender
This seems unreliable
Either with 3/16 point or 1/16
put + variable amounts
both strength
At times loud on Zero
but I cant hear it
all on box + yet

(5)

[ITEMS(S) FOUND IN BOOK]

once I heard it at 10 –
but generally only 4
it takes 2 or 3 times
as much KOH as
Carb Strontia & generally
the other cylinders –

I think I have just found a
Bug in all previous Experiments
When I use organic matter
in brush for coating
for instance Cotton, the
alkali attacks Cotton
& the stuff comes off
as a Colloid, the KOH
in soaking in the
chalk etc cylinder

[61]

[ITEMS(S) FOUND IN BOOK]

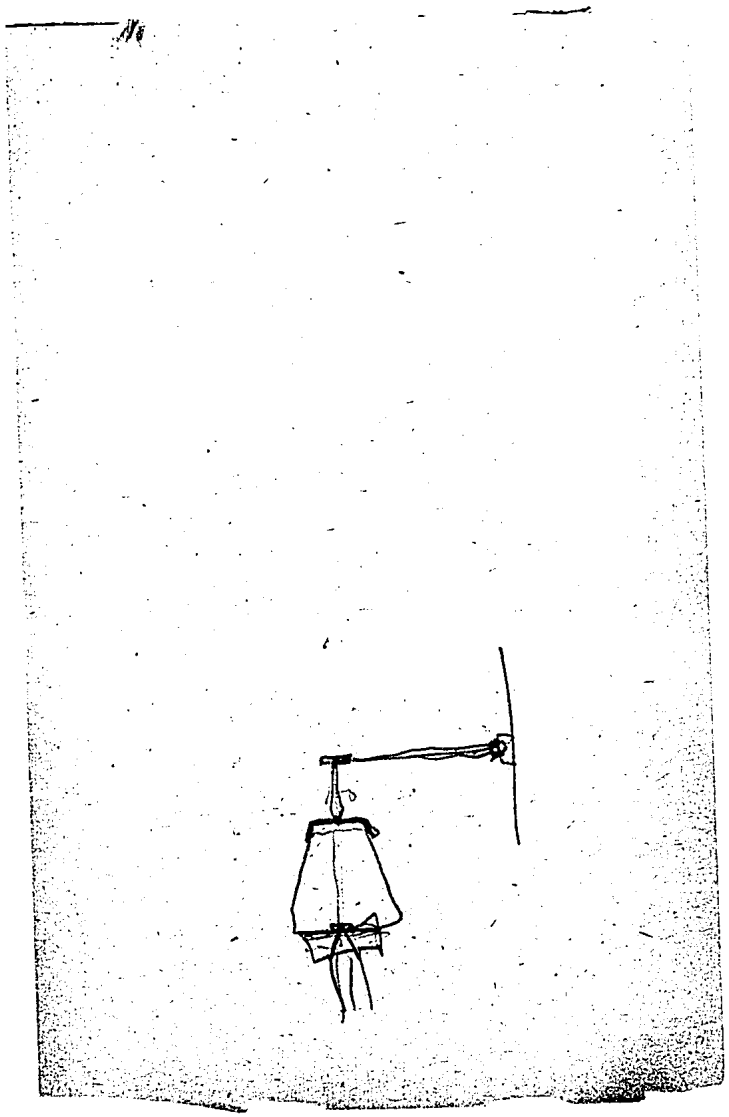
leaves all the Colloid on
the surface & we really
are not working on the
material the chalk.
is made of but always
on the Colloid, The more
we wet it the thicker
the deposit gets, I
am now trying rubber
sponge also thin sheet
rubber 3/8 of which is cut
in threads & bunched to
gether to form a sort
of a Brush -
Tried it - it works ok
but results no better
as I must boil the
Rubber, to get Sulfur out etc.
fine rubber sponge wholly
sponge

[C1]

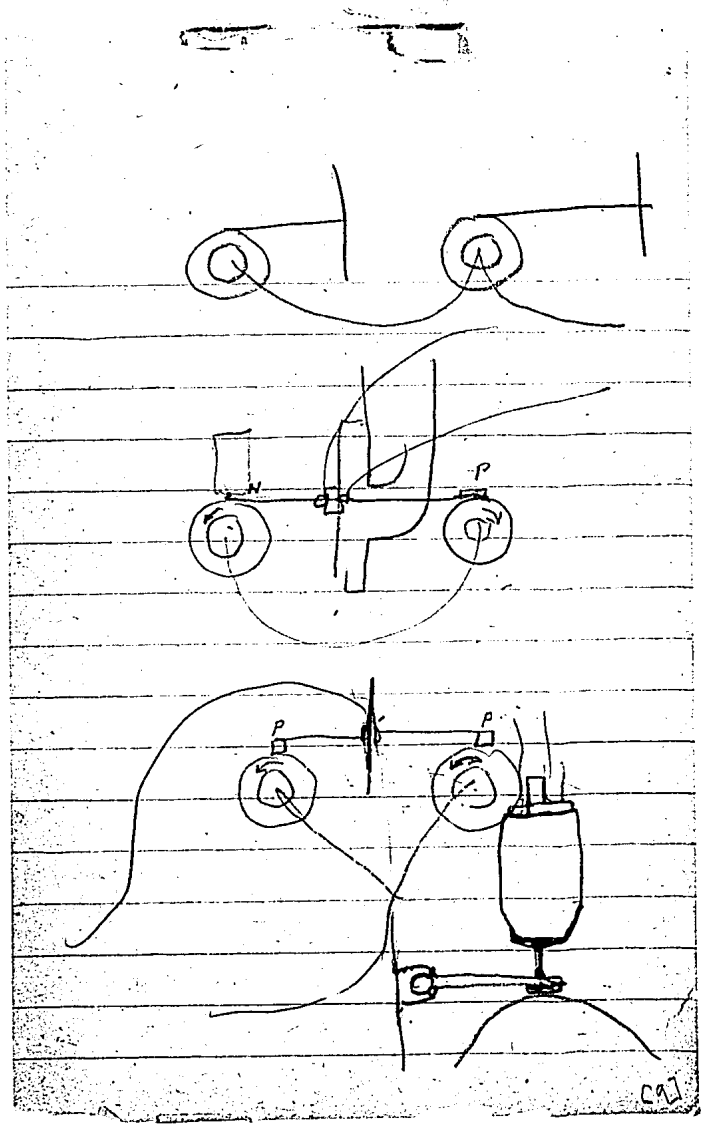
[ITEMS(S) FOUND IN BOOK]

I find another bug
used Calcined Mg - couldn't
get anything on Zero
took out pressure rubber
used finger pressing
to one side came
loose - This lever
never been right
will now make Universal
joint in it connection
to diaphm so palladium
plate will always
press on chalk flat,

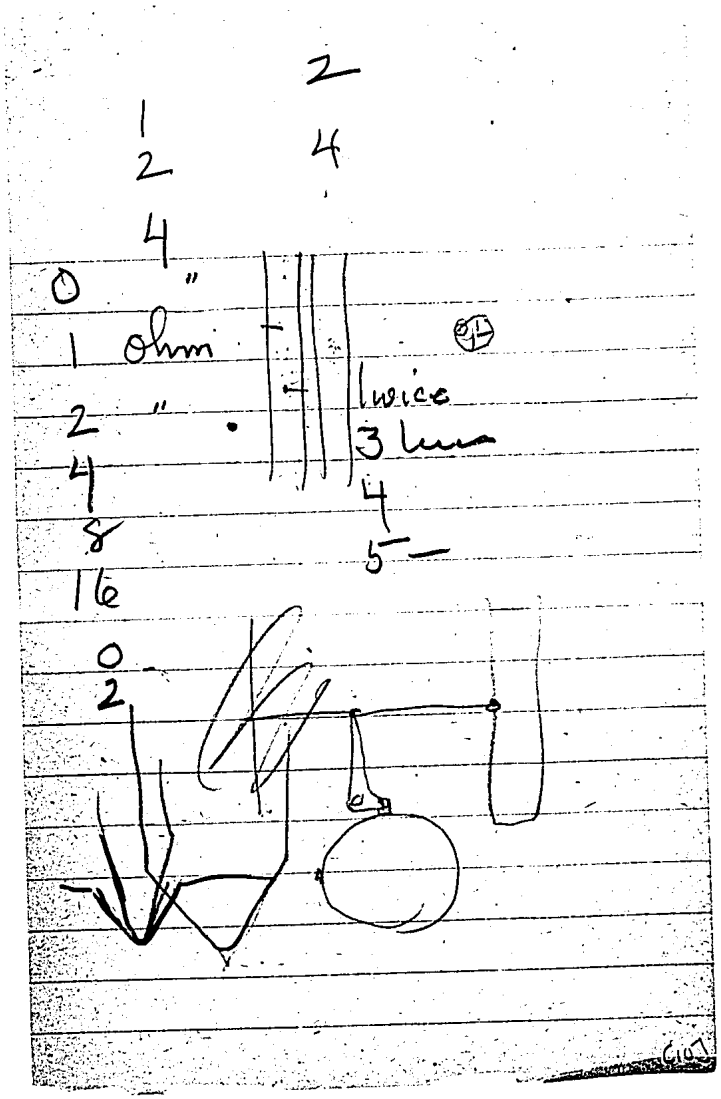
[ITEMS(S) FOUND IN BOOK]



[ITEMS(S) FOUND IN BOOK]



[ITEMS(S) FOUND IN BOOK]



Notebooks by Edison
Notebook, N-18-07-20

This notebook was used by Edison and Frederick P. Ott in July 1918. The book consists primarily of lists of compounds to be tried in chalk telephone cylinders. There is an index to the lists on pages 180-181. Inserted into the book are instructions from Edison to Ott, along with other loose notes. The front cover is labeled "Chalk Telephone (Lists)." The book contains 190 numbered pages preceded by 3 unnumbered pages. Many of the pages are blank.

2.5
1.2
3.7

7.5
0.7
8.2

Cylinders for Pilops July 20-21/15

9"/16 23"/32

1 - Kieselguhr Blg 24

2.5 gms Kieselguhr + 1.2 c.c. water ✓
67.6% " + 32.4% "
300 atmos.

China Clay Lion Brand C.B. Crystal N.Y.
5.25 gms China Clay. no water ✓
100% "
200 atmos.

Rotten Stone (Smoke) Keystone Chemical Co.
4.5 gms — no water ✓
100%
200 atmos.

Lithophone (Ponolith) Kuhn Pigment and Chemical Co.
200 atmos.
7.5 gms no water ✓

Blanc Fix Chlinchfield Products Corporation Johnson City Tenn.
7.5 gms 200 atmos. no water ✓

Fe2 mod's from Oxalate for Mr. Edison
6.5 gms Fe + 0.7 cc. water
90.28% Fe + 9.72% water
200 atmos.

Iron Oxide from Muffle Fe 4625-28

65 gms. Iron Oxide + 0.5 cc. water

92.85% " + 7.15% water ✓

200 atmos.

Strontium Oxide (hydr. cryst. CP).

4.75 gms — 110 water. ✓

200 atmos.

Acid Tungstic CP. (Crystals powdered).

7.65 gms - no water. ✓

200 atmos.

1	2	3	4	5	6	7
Material	Quantities formulae one Cylinder $\frac{23}{32}$" Dia by about $\frac{7}{16}$" Length		Percentages		Pressure Atmospheres	Actual Length of cylinder using quantities given in Column 2 + 3 (measured)
	Material	Water	Material	Water		
	grams	c.c	%	%		
BLANC FIX Chlinchfield Products Corporation, Johnson City, Tenn.	7.5	0	100	0	200	$\frac{1}{2}$"
CHINA CLAY Ring Brand C.B. Chrystal, N.Y.	5.25	0	100	0	200	$\frac{1}{2}$"
KISSELGHUR Bld. 24.	2.5	1.2	67.6	32.4	300	$\frac{15}{32}$"
ROTTEN STONE (SMOKE) Kyotine Chemical Co.	4.5	0	100	0	200	$\frac{20}{64}$"
LITHOPHONE (Ponolith) Krebs Pigment + Chemical Co.	7.5	0	100	0	200	$\frac{20}{64}$"
ACID TUNGSTIC C.P.	7.65	0	100	0	200	$\frac{7}{16}$"
STRONTIUM OXIDE (Hydr. cryst. C.P.) Eimer + Amend.	4.75	0	100	0	200	$\frac{7}{16}$"
IRON OXIDE from Muffle Fe4625-28	6.5	0.5	92.85	7.15	200	$\frac{20}{64}$"
Fe made from Oxalate	6.5	0.7	90.28	9.72	200	$\frac{7}{16}$"

Blanc Fix

China Clay	5.25 gms at 200 atm.
Kieselghur	67.6% 2.5 gms + 32.4% 1.2 cc 2% KOH Soln 300 atm.
Potten stone	4.5 gms at 200 atm
Lithophone	95.2% 7.9 gms + 4.8% 0.4 cc. 2% KOH Soln. 400 atm.

ACIDS

Tungstic Antimonic Molybdic	96.6% 8.5 gms + 0.3 cc H_2O (3.4%)	300 atm.

Press in Chemical room 5" ram

Light Calcined Magnesia

Pressed dry 4.5 grams to make roll at 750 lbs 13/32 thick pressure O.K.

500 lbs 3.9 grams to make one roll 13/32 thick
Dry pressed

1000 lbs 4.4 grams to one roll
Dry pressed

1500 lbs 4.7 grams to one roll
Dry pressed

400 lbs 4. grams to one roll
Dry pressed

300 lbs 3.6 grams to one roll Dry pressed

200 lbs 3.4 grams to one roll
Dry pressed

100 lbs 3. grams to one roll
Dry pressed

MAGNESIUM

Silicate
Hydroxide
Citrate
Ethyl Sulphate
Oxalate
Fluoride
Formate
Sulphite
Acetate

made in 3 different ways. Nos 1, 2, 3.

Oxide (Light Calcined Magnesia)
Carbonate
Phosphate
Borate

See page # 6.

STRONTIUM

Oxide
Carbonate
Carbonate and Aluminum Hydroxide - Mixture
Antimonate
Oxalate
Fluoride
Sulphate
Salicylate
Borate
Arsenate

CADMIUM

Oxide
Hydroxide

IRON

Oxide
Ferric Hydroxide
Citrate
Borate (Ferric)
Sulphide (Lumpes Reagent)
Tannate (Ferrum)
Carbonate (pure)
Phosphate, Ferrous true.
Iron, made from Am Fe SO_4 Crystals No HgO.
Oxalate (Ferric)
Hydroxide, Colloidal Ferric

NICKEL

Oxide
Hydroxide
Citrate
Oxalate
- Ammonium Sulphate

BARIUM

Carbonate
Antimoniate
Ferrate
Hydroxide
Borate
Arsenate
Phosphate
Sulphate (Blanc Fix)

CALCIUM

Tungstate
Hydroxide
Sulphide
Silicate
Arsenate
Oxalate
Chromic
Citrate
Acetate
Sulphate
Ferrocyanide

SODIUM

Uranate, (Yellow Hydrated)
Antimoniate

BISMUTH

Oxide
~~Hydroxide~~
Oxychlorate (oxychloride)
Sub-carbonate

LITHIUM

Phosphate
Carbonate

ALUMINUM

~~Hydroxide~~

Oxide · pure anhydr. (can't make)

Chromate

~~Alumin Sulphate CP.~~

MAGNESIUM - AMMONIUM

Phosphate

TIN

Hydroxide (Stannous)
Oxide, Black (Stannous)

ZINC

Hydroxide
Oxalate
Carbonate
~~Bromide~~ Sulfiquo
Oxide
Sulphate

MERCURY

Hydroxide (Mercuric)
Oxide (Red)

LEAD

Hydroxide
Oxide (Yellow, PbO)
Phosphate (Highest Purity)
Nitrate
Peroxide

MANGANESE

Hydroxide (Manganic)
Acetate
Oxide, Black
Carbonate
Borate

COBALT

Hydroxide (Cobaltic)
Sulphate

COPPER

Hydroxide (Cupric)
Oxide
Carbonate

CHROMIUM

Hydroxide (Chromic)
Colloidal Hydroxide (Chromic)

ORGANIC

Anthracene
P. Amido Phenol
P. Amido Phenol Hydrochloride
Para Phenylene Diamine Recryst. from Benzol M.P. 140°C.
Benzidine
Benzidine Sulphate
Naphthalene

OXIDES

Strontium
Iron
Cadmium
Nickel
Bismuth
Magnesium (light calcined Magnesia)
Aluminum
Zinc
Mercury (Red)
Tin, Black (Stannous)
Manganese, (Black)
Copper
Lead

CARBONATES

Barium
Strontium
Mixture Str. carb. and Al. Hydrox.
Magnesium
Iron
Zinc
Manganese
Copper
Lithium

SILICATE

Magnesium
Calcium

TUNGSTATE

Calcium

URANATE

Sodium (Yellow Hydrated)

PHOSPHATE

Lithium
Magnesium-Ammonium
Magnesium
Barium
Ferrous (true)
Lead

HYDROXIDE

Aluminum
" and Strontium Carbonate Mixture
Ferric
Calcium
Magnesium
Stannous
Zinc
Bismuth
Mercuric
Lead
Cadmium
Manganic
Cobaltic
Nickel
Cupric
Chromic
Barium
Ferric, (Colloidal)
Chromic, (Colloidal)

ANTIMONIATE

Barium
Sodium
Strontium

FERRATE

Barium

Citrate

Magnesium
Calcium
Iron
Nickel

ETHYL SULPHATE

Magnesium

OXALATE

Magnesium
Calcium
Strontium
Ferric
Zinc
Nickel

FLUORIDE

Magnesium
Strontium

FORMATE

Magnesium

SULPHITE

Magnesium

ACETATE

Magnesium
Calcium
Manganese

SULPHIDE

Calcium
Iron

ARSENATE

Calcium
Barium
Strontium

CHROMIC

Calcium

SULPHATE

Calcium (Plaster of Paris)
Strontium
Zinc
Nickel-Ammonium
Cobalt

BORATE

Barium
Strontium
Ferric
Manganese
Magnesium

SALICYLATE

Strontium

TANNATE

Ferrum

CHROMATE

Aluminum

BROMIDE

~~Zinc~~ Bismuth

NITRATE

Lead

PEROXIDE

Lead

SUB CARBONATE

Bismuth

Oxychloride

Bismuth

FERROCYANIDE

Calcium

Acids	5	Organic	90
Magnesium	7		
Strontium	7		
Cadmium	9		
Iron	9		
Nickel	11		
Barium	11		
Calcium	13		
Sodium	13		
Bismuth	15		
Lithium	15		
Aluminum	17		
Magnesium Ammonium	19		
Tin	21		
Zinc	21		
Mercury	23		
Lead	23		
Manganese	25		
Cobalt	25		
Copper	27		
Chromium	27		

Oxides	101	Sub-Carbonate	129
Carbonates	101	Oxychlorate	129
Silicate	103	Ferrocyanide	131
Tungstate	103		
Uranate	105		
Phosphate	105		
Hydroxide	107		
Antimoniate	109		
Ferrate	109		
Citrate	111		
Ethyl Sulphate	111		
Oxalate	113		
Fluoride	113		
Formate	115		
Sulphite	115		
Acetate	117		
Sulphide	117		
Arsenate	119		
Chromic	119		
Sulphate	121		
Borate	121		
Salicylate	123		
Tannate	123		
Chromate	125		
Bromide	125		
Nitrate	127		
Peroxide	127		

[ITEMS(S) FOUND IN BOOK]

Fred Ott,

Have Deans mak 3 each of
Silicate of Magnesia -
Carbonate of Strontia
Copper Oxide same as he used before

Jump up + bring your new
diaphram up to garrage let
me know on phone when
ready

Elmer

[ITEMS(S) FOUND IN BOOK]

Inorganic (1)
2 sheets

Aluminum	Acetate	✓
"	Fluoride	O
"	Oxide (specially made)	O
Potassium	Alum	
Sodium	Alum	
Antimony	Oxide	O
"	Sulphide (tri)	✓
"	" (penta)	O
Cadmium	Oxalate	✓
"	Sulphate	O
"	Phosphate	O
"	Carbonate	✓
Cobalt	Oxide	✓
"	Sulphide	O
Copper	Oxalate	O

[ITEMS(S) FOUND IN BOOK]

Inorganic (2)
2 sheets

Lead Chromate	✓
" Oxalate	O
Mercuric basic Carbonate	O
" Oxalate	O
Mercurous Chloride (Calomel)	✓
Molybdenum Oxide	✓
Nickel Carbonate	O
Silver Oxide	O
" Oxalate	O
" Sulphate	✓

[ITEMS(S) FOUND IN BOOK]

Aluminum Acetate
Antimony Sulphide
Cadmium Oxalate
" Carbonate
Cobalt Oxide
Lead Chromate
Mercurous Chloride
Molybdenum Oxide
Silver Sulphate

[ITEMS(S) FOUND IN BOOK]

ORGANIC

Organic (1)
1 sheet

Alizarine
Anthraquinone
Hydrazobenzene
Azobenzine
Benzoic acid

Bromphenol (tri)
Dinitro-benzine
Fluoresceïn
Hexachlor benzine
Naphthol (α)
" (β)
P. Nitraniline
Nitro-naphthalene
Picric Acid
Tetrachlor-naphthalene (can't grind)

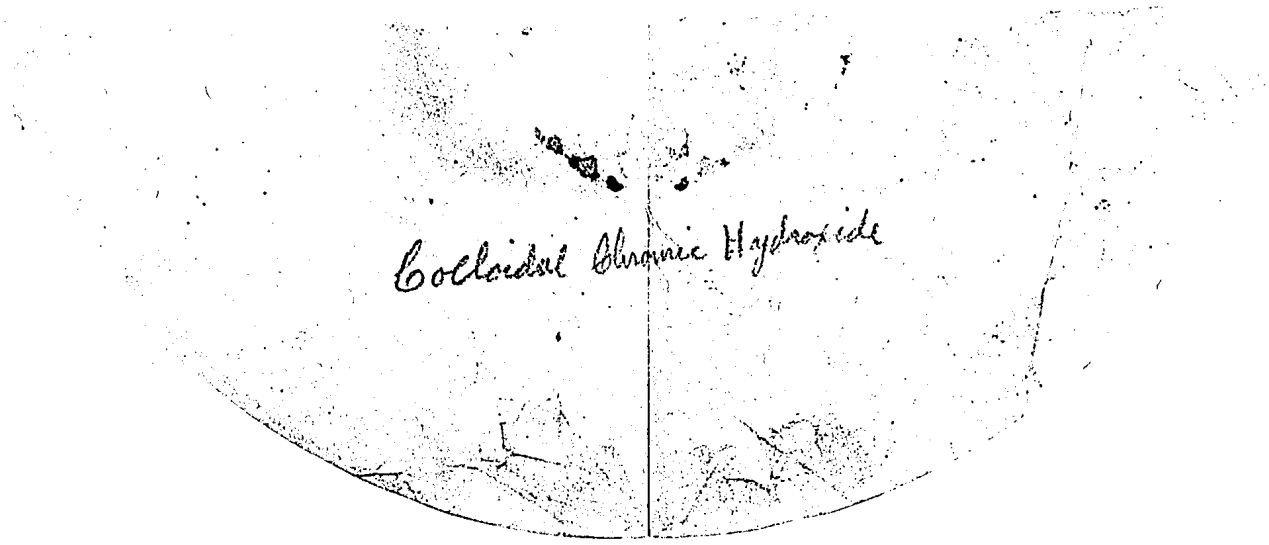
[ITEMS(S) FOUND IN BOOK]

Strontium	Carb	30
"	Oxalate	38
Calcium	Oxalate	32
"	Silicate	34
Magnesium	Fluoride	24
"	Hydroxide	24
Copper	Oxide	32

[ITEMS(S) FOUND IN BOOK]

6 of Calcium Silicate ✓
3 Copper Oxide ✓
6 Oxalate Calcium. ✓
6 Strontium Oxalate. ✓

[ITEMS(S) FOUND IN BOOK]



Notebook Series -- Notebooks by Edison
Notebook, N-18-07-24.2

The dated entries in this notebook are from July 1918 and August 1922. The entries for the earlier period may have been copied into the book in 1922. Included are notes copied from N-18-07-18.2, along with abstracts of results from the same source, evaluating various chemical compounds to be used as part of a sound detection device or chalk (phone) electromotograph. The 1922 entries relate to additional experiments performed with chalk phones tested in a variety of circuits, under differing conditions, or using different metallic contacts. The notes indicate that William A. Hayes assisted Edison with these experiments in 1918, while Frederick P. Ott assisted in 1922. The front cover is marked "Chalk Phone" and is labeled "Chalk Phone Fred Ott." The pages are unnumbered. Approximately 30 pages have been used.

Copied from other book

July 24 1918

Tried Exp'mts on Chalk Phone using Strontium Carbonate 21% KOH

With Bell receiver connected to Cylinder Phono by 6" rubber tube 3 Stage Audion Using Band Record 15000 ohms in circuit Edison hears to 30 on box Others listening to Bell phone can only hear 16 18 on box

Have small regular phono reproducer old style Cup Mica dia 15/1000

Using Stethoscope Edison hears no scratch, Hayes says he only hears gears

Kisselgur 16 on box
Tungstate Calcium 18 @ 20 on box too soft - Promising

CENTRAL STATIONERY CO.
12 EAST 16th STREET,
NEW YORK
TO RECORDER USE
ber 22198

Cracks when wet shrinks but still works

China Clay – not a sound
Following tested with limit on
Box = Bell on Box 16 Limit

Kisselghur	16
Tungstate Calcium	20
China Clay	0
Rotten stone	0
Strontia Oxide	4
Lithium Phosphate	Poor
Bismuth Oxide	Poor
Uranate Soda	Poor
Cadmium Oxide	Poor
Magnesia Silicate (Native)	0
W Va Limestone	0
Aluminum Hydrox	30
Lithopone	6
Tungstic Acid	5
Strontium Oxide	16
Mag Amon Phosphate	8
Soda Antimoniate	0
Barium Antimoniate	10
Silica	12
Ferric Ox fm Oxalate	8
Blanc Fix	2

Will not stand much KOH gets soft
" "

Mix of Al_2O_3 + $SrCO_3$	12
Cylinder K Alum	0
Li Ox ignited Oxalate	8
Ferric hydrox	0
Calcium Hydrox	8
Cadmium "	½
Lead "	0
Mercuric "	12
Magnesium "	30
Zinc "	26
Stannous "	0
Cupric "	0
Cobaltic "	5
Ferrate of Barium	0
Manganic Hydrox	0
Magnesium Sulphite	0
Chromic Hydrox	Crumbles
Magnesia Phosphate	12
" Oxalate	4
" Citrate	12
" Acetate	0
Copper Carb	0
Litharge	0

Lead Phosphate	0	
Calcium Ferrocy	28	—
Red Hg Oxide	22	—
Lead Sulphate	0	
Colloid Ferric Hydrox	0	
2 Gy H	0	
Barium hydrox	2	
Light Calcined Magnesia	26	—
Magnesia fluoride	30	—
Calcium Citrate Crumbles	—	
Zinc Ox	12	
Calcium Sulphide	6	
Strontia Salicylate	—	NG
Ferric Borate	8	
Strontia Oxalate	38	=
Carb Magnesia	12	
Barium Phosphate	16	
Calcium Arsenate	26	—
Calcium Oxalate	32	=
" Sulphate	2	
" Chromate	20	—
Zinc Carb	0	
Strontia fluoride	10	
" sulphate	4	
Ferrous Phosphate	14	

Flakes up Considerable Roll
works off

" 30 on bag very strong to 24 - Cracked
smooth -

Batt 16 on 60 ~~Crap shrinks~~ Expt

Crumbles
1 V. Very Loud on short clot

	Magnesium Borate	9
Cracked mercury but OK	Black Stannous Oxide	28–30 —
	Strontium Borate	28 —
	Aluminum Chromate	24
	Bismuth Sub Carb	2
	Ferric Oxalate	0
	Bismuth Oxychloride	0
	Zinc Oxalate	8
	Barium Borate	14
works on light pressure not hard on Zero but 32 on 6 ox	Copper Oxide 5	32 —
	Magnesia Formate	12
hard at Zero – taken Ammonia KOH 6 times req works well after saturation + wiping off quite 20 on 6 ox	Calcium Silicate	34 =
	Peroxide Manganese	0
	Manganese Carb	0
	Lead Per Ox	0
	Iron Sulphide	0
	Barium Arsenate	8
	Strontia Antimoniate	20 —
	Strontia Arsenate	20
	Mangan Borate	14
	Nickel Ox	0
	Lithia Carb	6
	Benzidine Sulph	0
	Amidophenol p –	0
	Anthracene	0
	Naphthalene	0
	Amidophenol Hydrocl	0

The following are the chalks that can be investigated.

Aluminum hydrox	30
Magnesium "	30
Zinc "	26
Calcium ferrocyanide	28
Red Hg hydroxide	22
Light calcined Magnesia	26
Magnesia Fluoride	30
Oxalate Strontia	38
Calcium Arsenate	26
" Oxalate	32
" Chromate	20
Black Stannous Oxide	30
Strontium Borate	28
Aluminium Chromate	24
Copper Oxide	32
Calcium Silicate	34
Strontia Antimoniate	20
Strontia Arsenate	20

Ca salts	5 cases
Sr "	4
Mg "	3
Al	2

Since these tests have been made further tests have been made without Audion with great improvement in sensitiveness, using phonogh Bell receiver as sender & a Amberol Band record.

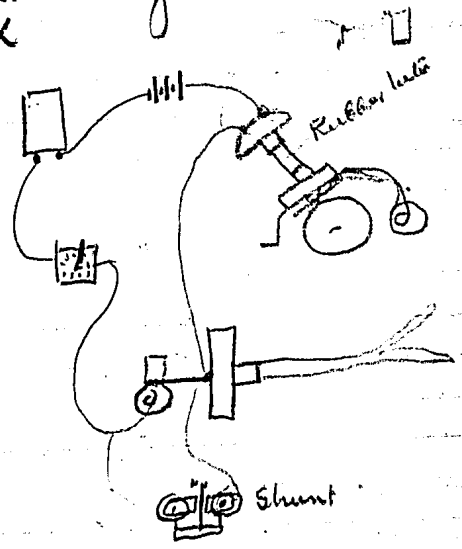
The first improvement was putting a 5 Microfarad Large type Quad Condensers in Circuit and then putting in circuit 7 Cells of storage Battery Cells say 8½ Volts

The next great advance was made by shunting the MgO cylinder contact, with a Quad polar relay. This greatly increased the Sensitiveness, smaller inductance like Brunall Coils not so good.

The next advance was

by putting a insulating rubber sleeve on shaft & using Copper washers so the two end poles of Chalk was Copper some oxidized This increased sensitiveness still more.
Also proved that Palladium was the best pen from Diaphm -

Without audion & these arrangements got 20 on the 6-X



without Condensers or battery using MgO Edison couldn't hear anything on Bell phone

Then arranged it with Condenser + Battery -

Edison hears it Loud but when turn on BOX A to advance one point don't hear it, or anything on Bell

I reverse battery + get nothing hence the Condenser + battery is an advance beyond a certain number of cells in battery it don't increase Volume

Put in a MgO 750 lbs. hydraulic pressure used in making moulded dry no water used porosity greater when moulded dry powder, Takes more KOH + dries quickly - track good without tearing Can hear now on one button from

Zero on No 2

It is best to wet MgO & let it dry before pressure put on Rubber powder to form Track

Our Bell sounding phone is 1100 ohms -

MgO dry moulded at 500 lbs is better than 750 or 400 with 500 lbs heavy To 8 on box
But it is less loud on Zero or No 1 - more porosity is Explanation probably

After Standing on Zero got Considerable more volume but Edison Could not hear beyond #8

Fred Ott tried it & got 24 on box + 12 on Bell Phone This is the 500 lbs MgO.

We dupard the 500 receiver
it was just the same

500 is somewhat softer
and then forms a recess
which makes good contact

with 750 too hard to do this
hence only touches points

Made a 400 heard it to #8

Egerton says 6 points on
box cuts current 1/2
Each notch or point is 1 mile
telephone wire 44 Ohms —
with a Condenser across .054
Mf

We use pieces of rubber sponge
to add KOH to MgO.

Removing the Cells in ckt
Scarcely audible on Zero
point. While battery is in ckt
reversing poles make no change

Thinking polarization may
have some effect at Contacts
with the MgO I put in Copper
Washers forming side of
Mandrill Contacts + put a rubber
sleeve over shaft.

Even with a platina pen which
is 1/2 as loud as Palladium
I hear to 8@10 –

By putting in Palladium
pen Echo can hear to 12 on
Box Think he hears 14
on Zero its Loud + Clear
+ it dont drop so much on
going to NO 2 point

Reversing poles on MgO
Very Little Effect

It seems to want both
poles non polarizable
Ag. Pb Zn Washers poor.

Oxidized face of Copper washer
& scraped part free, platinum
pen & on box -
Reversed poles on Mg Carbon
Load then went low, put back
again regular Carbon Cathode
Hear to #10 -

Think MgO should be 1/8"
longer; Palladium point only
1/16 from edge

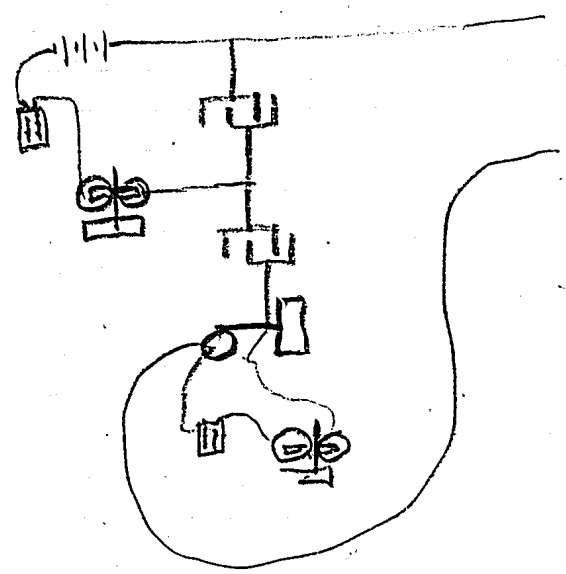
Try using 7 Cells its best.
By putting in a Rounder in
Current weakens very much

By shunting MgO with
polarizer relay from a Quad
it increases sensitiveness
Enormously & hears to # 20

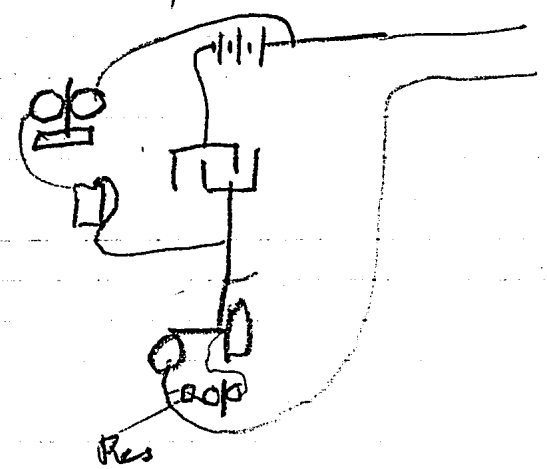
5 Mf on line

Aug 24 1922

Some new ideas to be Tested on Chalk phone



Aug 27/1922



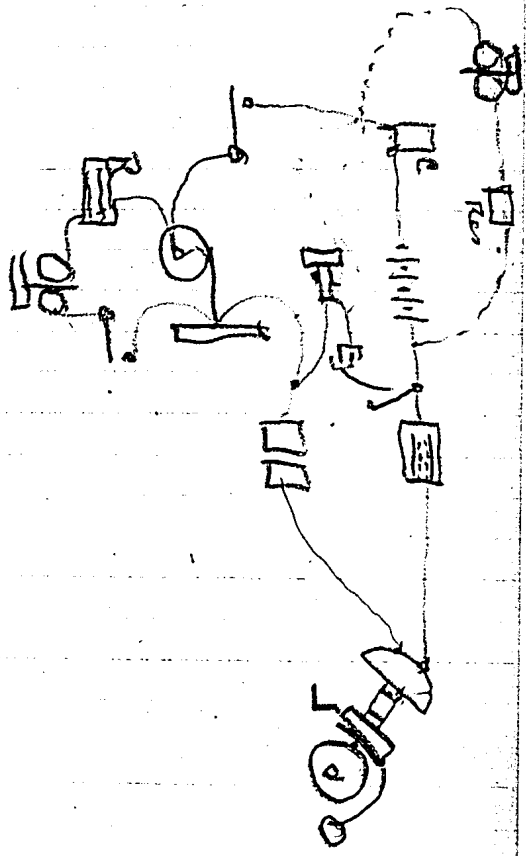
Determine two best Chalk phones in series or Multiple arc by Box

Aug 24 1922

for depolarizing poles against MgO phase

1 Silver with Black Ox
2 Nickel " Ni hydroxide
3 Cobalt " Co perox
4 Copper " Cu hydrox
5 Copper " amalgamated
6 Palladium faced vacuum
7 Platina - platinum black face
8 Palladium + Palladium black
9 Copper Tellurium melted on
10 Copper Selenium "

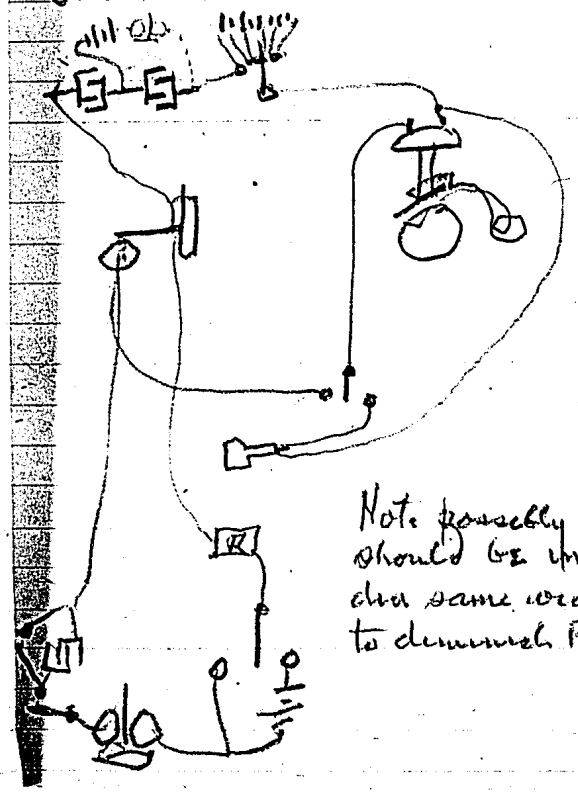
Aug 24 1922



Aug 24 1922

Make a smaller Chalk phone but with diaphram & Cup just like our doc reproducer but dia of chalked paper but .008 .008 .008 .010

Try an Audion bulb to straighten out Current



Note possibly Mg O should be inch dia same width to dummach Resonator

Previous experiments showed that with MgO Condr + Gallery with wet chalk (Cryfer working 1/2 reduced) was put over mercury and in 24 hours could still hear Mercury. KOH probably got carbonated feel sure in closed space air tight + sponge to saturate atmosphere with CO_2 ok for 24 hours at least

Noticed by reversing direction of chalk rotation increased loudness thus shows there is still room for improvement

Finger must not touch MgO as grease destroys action,

Remark

1) Left MgO all night wet cloth very wet. in the morning found some 1/2 Volume by wet it with water & let it dry without pressure on got 3/4 of the Volume of Vacuo, again wet with more water in excess took several minutes to dry then got full Volume of Vacuo, this was with a ~100 gauge pressure of MgO

Try some experiments with Better MgO on boxes with large or small Inc Rec boxes possibly the improvements in some cases is due to lowering Rec of MgO

In welding 500 MgO put more than Req pressure on to form grooves & smoothed track then put to Req pressure

With Condenser & Battery in Circuit reversing poles of MgO makes big difference with Copper washers reversing poles on MgO makes very little difference

We must get non polarizable MgO Contacts apparently

By putting in a Condenser in the General Circuit loudness is very much diminished

Look out that poles of MgO may not get Changed on alternate battery & Effect Subsequent Involving all the Experiments if they do the same must be reduced to Minimum Capacity

Aug 26 1922

Tried MgO Check but it was too heavy at 500 lbs 8" ram — Couldnt get no fuel on Bell phone —

Now will run a series of 6 MgO made on 8" ram at different pressures

1st Trial 100 lbs pressure on 8" Ram.

Next MgO with 2 deps of Rubber Sponges no pressure on let it dry 5 minutes

Fired heavy Bell 14 on box —

Brand Record 6200 Ohms in Line Res

E hears nothing the Cylinder Compressor at the track OK

Shot it twice nothing
twice again nothing
twice again - nothing
put on heavy pressure
Crumbled the MgO

Shoot me 150 lbs on 8" ram
MgO - 4600 Res in
tube — 2 Rubbers full 20% KOH
Let in dry for 10 minutes
before putting on pressure
Edison gets on Zero
Fred OCL on 12
3000 ohm in line
E hears on Zero only
150 lbs makes quinken
back but it is slightly
darkened by weakening of
the Palladium
Its poor

We now put in 200
lb pressure MgO 8" ram
3000 ohms in line

We have in all these Expts
5 2½ Mf Condensers in
multiple & 7 cells A4
in line –

E heavy ~~4~~ on box 1 Gray
Zeno. Fred 18 on box

Bell Fred heavy 20
10 min after Edison 6
on box 3000 Res
No matter with Mag
KOH, Harder pressure
Cannot get above 6
on box ~~3000 Res~~

250 pressure 8" Ram
put pressure on 150
hard before, it got hard
after letting it
Crumbled
3000 Res in line

Now put in 300 lbs
pressure 8" Ram -
I get 8 on 60x feed
gets 22 on 60x
Fred gets 22 on 60x

Notebook Series -- Notebooks by Edison
Notebook, N-18-08-13

This notebook was used by Edison in August 1918. The entries pertain to the construction of experimental blanks for disc records. Included are accounts of mixtures of chalk, rosin, and wood flour or cotton flock. Some entries describe the unsatisfactory records produced or offer observations on "the proper way to mix" ingredients. One of the notes indicates that Archie D. Hoffman assisted Edison with the experiments. The pages are unnumbered. Only 8 pages have been used.

Experiment with 3 gal mixer
Aug 13/1918

mixing 4 wood 3 Chalk 1 Rosin

Mixed OK using 1/2 the alcohol having twice the Rosin per CC but total Rosin ~~[illegible]~~ as above about 12 1/2% of total —
Mix OK.

Tried a batch Req amount of Rosin -
250 wood
190 Chalk
56 Rosin —
Dissolved in 1/4 of the amount of alcohol usually used
Came out OK Made a blank which was OK —
but of course not reground
(dried it in air)

finally today -
Mixed in 3 gal mix
4 parts ~~[illegible]~~ Wood flour
3 parts Chalk
1 part Rosin Melted
no alcohol used

Divided the wood into 4 portions of 375 grams each
Put in one part wood & all the Rosin at
1 PM -
1 05 Stopped to clean gob from stirrer Commons & Seals
Remarks charged have put in 2 portions 750 grams

at 110 put in 2nd portion of coaal —

at 115 stopped mill to clean out corners & rocks —

1,35 pm put in 3rd portion of coaal found it semi sticky & OK — Hopper should be lagged —

2 pm put in last portion of coaal

2 25 put in 1st portion of Chalk.

2 40 pm put in 2nd portion of Chalk

2 55 pm 3rd portion Chalk put in.

310 pm - last of Chalk -
Run until 3.25 pm &
removed mix - Cooled
it off & sent to Haffner
to screen & make 2 blanks
found coarse lumps
rich in Resin —

Fried

2700 Chalk
540 Rosin
518 flock -

Method Rosin -

Put all flock in + rosin - at
10 am -

1015 put in 900 gram Chalk
1035 " 900 more
11 am 900 "

1130 Removed - found that
flock not spread but lumpy
chalk not stuck to it from
want of Rosin -

Records made 19 - Very noisy + not filled

The proper way to mix
Formula | Aug 15/1915

540	Melted Rosin
518	Cotton flock
2700	Chalk

Put 1350 grms chalk in + all the Rosin — at 1 PM at 1.25 pm. it was very tenacious dough + gooey together — 1.26 put in 1/3rd of the flock

1.37 pm. put in 1/3rd more of flock

1.50. put in balance of flock

at 2.20 pm flock was all pulled + not discernable the dough being tough + tenacious

at 2 20 pm put in 450 grams Chalk -

2.40 pm put in 450 more chalk

3 05 put in last of Chalk

Run till 3 35 pm & removed

Under micro fibres scarcely seen all well distributed throughout the Chalk -

Towards the end became rather dry & present mixer having a clearance well not breaks up the 1/8 size lumps hence its lumpy & this shows up when blank made if there was some spring to mixer paddles the mix would be perfect -

This shows that to distribute & pull apart the flock fibres it's essential to work the mixture so that at first a tenacious dough is formed. When the flock is added & its this sticky dough that pulls apart the flock balls & separates the fibres. Without this dough the flock cannot be mixed at all.

Notebook Series -- Notebooks by Edison
Notebook, N-18-09-01

This notebook was used by Edison in September 1918. The entries pertain to the construction of powder blanks for disc records. Included are notes on two standard mixtures for making blanks and three schedules for baking them. The blanks consist of rosin, chalk, and flock in differing proportions, and the schedules involve gradual heating of the blanks before varnishing and printing. There are notes on the viscosity of rosin at various temperatures, the quality of blanks obtained, and the methods of mixing and forming blanks. One entry has a table of "Properties of alloys of Rosin & Resinate of Manganese." Another includes notes on testing various fillers for iron. The notes indicate that William W. Dinwiddie and Charles T. Dally assisted Edison with the experiments. The front cover is labeled "Edison A" and "The August 1918 Record." The pages are unnumbered. Approximately 25 pages have been used.

Mixing Formula - No 1 Sept 1 1918

Proportions

120 grams. Rosin [I] grade
300 " Chalk
28.8 " Short Flock

Weigh out chalk in three parts

Add all the flock, all the melted rosin & put in 1st part of the chalk mix till tenacious dough, then add 2nd portion of chalk, mix till tenacious dough, finally add last portion of chalk & mix too tenacious dough -

Keep mixer hot using 15 to 20 lbs steam and mixer lagged to prevent radiation & loss of heat,

If higher melting point Resins

are used, increase steam pressures

Properties of alloys of Rosin & Resinate of Manganese

Proportions	grms	Color at which piece first makes an impression by using a little pressure	Temp at which Thermometer just touches surface of oven when weight	Temp where mix is like Tar or heavy Varnish	Soft as Butter	Mix flows + rises to Top of liquid
Straight Rosin		126	135	167	194	212
100 Rosin	10 Mn Res	140	158	180	205	212
100 "	20 "	154	167	198	212	—
100	30	163	172	207	—	—
100	40	169	180	216	225	230
100	50	180	194	221	230	235
100	75	192	207	230	239	243
100	100	198	219	248	259	262
100	100 x	203	219	248	261	266.

boiled more

The small mixer holds

2700 Chalk
1080 Rosin
259 Flock.

Schedule # 1
Standard Sept 6 –

The Chalk being divided in 3 sections.

We heat the Blank Gobs in oven 1 hour & 30 min To 281° Fahr & then press To blank, press moulds being 135° Fahr

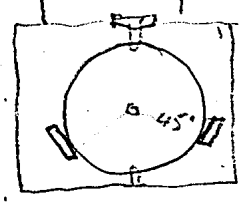
We baked varnished blanks on following schedule.

30 min 110 Fahr
30 " 120 "
40 " 140
1 Hour to 150
Held 5 hours at 150° Fahr

These blanks badly warped + although pressed for 8 hrs at 225 lbs steam + 125 lbs hydraulic

It wears.

I then made a change in the holding rack for baking the blanks



and baked on the following

Bake schedule

Schedule #1

30 Min to 110 Fahr
40 " 120 "
1 Hour to 130
1 " " 140
Hold 7 hours at 140.

Came out all straight

I notice on some a few raise ups 1/4" diameter + less,

Printed. Used Thermoweld.
2 Min Contact at 220 Fahr
12 " 100 lbs hydraulic pressure at 220 deg. Squeezed out thin sheet about 1½" wide — Record nearly perfect but not quite filled in few small spots.

Diamond run 20 times no Cutting — not scratch by finger nail —

Record also dropped on Desk platter 53 times 1 ft high before breaking -

Record had 2 places where dedit fill - probably bad blank - Baked blank on #1 Schedule -

Blank baked by #1 Schedule

Pressed by this Schedule

Contact 2 min at 150
High pressure 750 lbs at 150 for 4 min
Dropped pressure to 75 lbs &
put heat at 230° for 10 mins
its hard & OK but cracked
one half - probably should
have Contact for 4 min

We present another by this Schedule Except

4 mins Contact instead of 2 minutes.

Thus No One schedule

Use flattened blanks

Bring to Contact + hold 4 minutes when temperature has reached 160° by thermometer on platten.

Then keeping Temp still 160° Raise pressure to 750 lbs Hydraulic hold for 4 minutes,

Then reduce pressure to 75 lbs Hydraulic + Raise temp to 230° + hold for 10 min — then Chill —

Manganese Peroxide Experiment
Mix for small Machine
Chalk 2700 grains —
Flock 259 "
Rosin - 724 + ManganeRes 356
Total Rosin 1080,

Requires very much more heat in mixer. Couldn't mix with this machine & had to mix in Pint machine which it did ok — but got 4" not good — not Enough to make a blank.
We have now bagged

the 4000 gram Machine &
Can probably mix it OK.

We divide the chalk in 3
parts. All flock & Resin
+ 1/3 of Resin put in —
flock 1st then Resin, then
Chalk —
After tenacious got add
2nd part of chalk when
this tenacious add final
3rd & mix till OK +
tenacious —

No 4 Record printed by No 1
Schedule, — One side is Al-
only 1 snap other side 6 snaps 74
Either punch outs or bad blank
Vocuvision — general surface
fair to Edison good to Dina Really

Sept 10th —

Bake Schedule No 2

1	hour	to reach	110
1	"	"	120
1	"	"	125
1 1/2	"	"	130
2	"	"	140

Hold at 140 for 8 hours

No 1 Schedule worked OK

This is to prevent small bubbles & to help process schedule out reducing the time of hardening & long wears in oven

~~Nat~~

I note that the record prints made with No 1 Print Schedule, No 1 Bake Schedule - & para 8 6/4 Var are OK for smooth scratch etc or only defections by a few snaps due 1st to blank 010 pull out and bad varnish glowing holes so deep no amount of flock of blank will fill them —

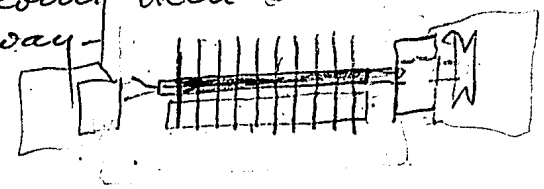
The ring in mould to reduce amount flowed out in printing is OK & helps to make a good fill —

What we need is a little more flock to make surface of blank stronger so varnish will not be torn off in spots when there is a slight tendency to stick to mould —

8 @ 10% flock probably OK —

We find that with 10" disc at high speed on our Emery wheel, the disk 40/1000 that slots are cut nicely with smooth walls into Cold globs. 1" in 10 sec with bigger belt can cut at 3 or 4 times this speed — also that when glob is hot it goes much faster.

Could squirt out a 4" long cylinder say 20" long — afterwards put in oven + heat + then cut in say 15 globs simultaneously while hot preventing unoxidized faces. the 2 extreme ends having then slice cut away —



Sept 12 1918

We now have baked 13 Varnished blanks & 6 unvarnish blanks by No 2 Schedule —

There are a few 1/4 blisters but the small bubbles are greatly diminished and all will print OK. These small bubbles average 010 circumference

Its hard to say what causes them We have 6 unvarnished blanks & we will Vary time & bake No 2 Schedule & if there 010 bubbles are still there this will prove its not the blank but due to Varnish

Among the varnished blanks in this lot is some with 6% flock & also 7% 8% & 9% flock — The amount of bubbles are about the same — but 6% which is the one we been using Reg bends slightly in holder but OK — It looks as if 7% flock is best.

Baked 15 of various kinds by
No 2 schedule.
They came out all OK
yet a little warped but
not very noticeable to type.
They are straight enough
for practice 8/0 flock
OK —
Daley varnished a block,
pressed in a smooth metal
till polished like a
record — They came
out fine — No bubbles
but numerous specks
stick up — possibly dust
point only 002 in size

Effects are felt in making
think vacuum were hard
no bubbles —

The Blanks that were
baked in process new
often vacuumed + baked
again had just as many
bubbles showing that
it is poor surface of
blank + lack of ice
that causes air to be
trapped by vacuum that
produced the bubbles
Everything shows that

a blank perfectly filled
there will be no bubbles
or if baked in oven
then a varnish will
ground there will be
no pocks or bubbles

126= Sept 16 1915
No 1 standard -
Standard mix for blank

Rosin	27%
Cotton (short)	8
Chalk -	65 -

This varnish bakes ok on
No 2 bake schedule - & fills
on blank pieces.

Shedule #1 for 126 standard mix

Blank press on 126 mix

Circulating water in press is kept at 47° Cent,

Pressure 925 lbs

Oven temp. 145° C

Gobs in 1½ hours.

We find standard mix #1 of Sept 16 has too much flock so it dont flow & fill as well as the old mix — It stands more than 10 drops 2 ft high & hence has enough amount of flock, 12% flock stands 10 drops 4 ft high

We now return to #old 70

Sept 18 1918

2 standard mix now to be used -

120 Rosin
24% flock
300. Chalk

This is

960	Rosin	26.6 %
230	flock	6.5
2400	Chalk	66.9

It would seem that more there is of flock the worse the fill & worse open surfaces

12% flock made 10 drops at 4 ft + 1 crack from Center to Edge in one place

This strength is entirely unnecessary-

Bake Schedule ~~set~~ No 3. for soft blanks using 5 Para -

1 Hour to reach		110
1 "	"	120
1 "	"	125
1 "	"	130

Hold at 130 for 8 Hours -

Tested fillers for iron

Magnesia Silicate, Very little, NCP
decomposes at some what giving free Silica

China Clay very little iron

Lion Clay no iron - OK

Rotten Stone careful iron $\frac{1}{3}$ no iron

Chalk not much iron might
say very little,

Notebook Series -- Notebooks by Edison
Notebook, N-18-09-05

This notebook was used by Edison in September 1918 to investigate chemical salts and solutions for use in Lalande primary batteries. Included are notes on the preparation of various compounds, reminders to check for the solubility of zinc hydroxide, and ideas for the construction of cells and electrodes. One note suggests using discarded electroplated record molds. Some notes indicate experiments to try in the future. The front cover is labeled "Lelande Experiments" and "Sept 5 1918." The pages are unnumbered. Only 18 pages have been used.

Mono Arsenite of Lead.
$PbO\ AsO_3 + x\,aq$ insol in KOH
but sol in NaOH.

Arsenite Manganese ppt.

Antimoniate of Cobalt 5 Sol H_2O
CoO, SbO_5 after ignition insol
in alkali.

ditto Copper
$CuO, SbO_5 + x\,aq$ after
ignition not sol acids or alkalis

Insoluble Antimoniate of Potash
$KO, 2\,SbO_5 + 6\,aq$
insol H_2O, sol in boiling
Conc KOH. but deposited
again on cooling. traces
left can be precipitated by
adding a Sol K Salt,

1 pt of Soda Salt in 350 pts of water is precipitated by Antimoniate of Potash

Antimonate Soda
$NaO.SbO_5 + aq^n$ 7 aq
almost insoluble in water
Sol in alkaline solution

Kermes Mineral -
$KaSbO_5 - 2SbS_3$
This is Antimonite of Potash & Tersulfide of Antimony, sol in hot conc sol of KOH, Soda Salt similar

(Basic Salts) - look up

Use large flake graphite like was used in first storage Bat to mixed the P pale stuff —

Ferric hydrox combines with (ortho acid) Arsenous acid Very slightly sol in water

Arsenates + Arsenites of heavy metals may act as P pals if flake graphite used to give conductivity

Schweinfurter Green also Scheele's green are Copper Salts, (Arsenic)

Hypochlorite of heavy metals,

Persulphides of heavy metals

Copper Nitrate (Basic) blue green powder very difficult soluble in water, Composition corresponds to Atacamite. Its remarkable as being one of the few Nitrates difficult soluble eq

$Cu_2(NO_3)(OH)_3$

Make series of Experiments with solution of many salt to get Zinc hydrox soluble etc.

(This is obtained by action of Copper carbonate on Normal Nitrate, or by precipitating (partial) of the later with a Carbonate. The Carbonic acid of which Escapes

Atacamite - $Cu_2Cl(OH)_3$
scarcely sol in Aq
its an oxy-chloride of
Copper -
Sulfure a $CuCl(OH)_3$

The hydrated normal Nitrate
Copper wrapped in tin-foil
foil oxidized vigorously
fires have been caused
by it,

$Na_2H_2Sb_2O_7$ is the insoluble
soda salt, try it in tubes
with grafolo
or soaked in CuO plate

Lots of queer Sb compounds

Salts of Thioantimonic gives
precipitate with heavy
metals insol in Aq

Soak CuO plate in
KPermanganate & heat
to decompose

Oxychloride of Copper probably not sol in NaOH,

Calcium Manganate $CaMnO_3$ also other Manganites, Try all that made $CuMnO_3$ if insol in NaOH try in graphite

Load $\frac{1}{4}$" tube with Black oxide Mn using Nickel flake as rod with Nickel, + try in NaOH with Zinc + also in $CHCl_3$ ammonia like Leclanche — possible reason Leclanche chose MnO_2 Strong Carrier to POST Controls this well Correct that —

Try the Wad Combn of Mn

Zinc hydrox dissolves in NH_4 or K Oxalate -

Discarded Ni Cop record moulds Roast in furnace to oxidize all the Copper to CuO & use ni at Williams works, & all the assaying here

Persulphates of Cu, Fe form basic salts by adding CuOH. or Fe_2O_3 hydrox to make insoluble NaOH or Chlammonia

ditto Nitrates
Bichromates
Arsenates
Arsenites
Antimonates
Borates –

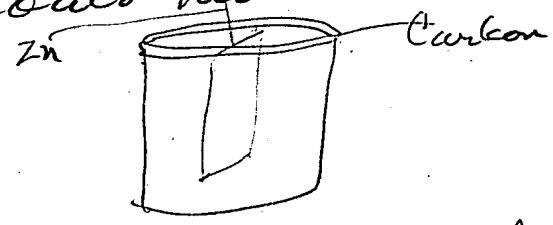
per

Strongly Cop slowly reduces
~~Nitrate~~ Soda to Nitrite Soda
Cold – put Nitrate Na in
NaOH, when Cu is reduced
from CuO this turns &
reduces Nitrate.

In presence of Cerous Salts
Atmospheric Oxy is
absorbed by Arsenious
acid

Mix Copper hydroxide with Kieselguhr
China clay or other powders
in mixing Machine or press plates
in hydraulic — Then ignite to
make CuOH go to CuO +

~~Mand~~ Carbonize some
Cocoanut or peach Kernel
~~[illegible]~~ put in Vac & then
let in Oxygen — then heat
~~for~~ depolarizer —
also in Coated reactive
Could Wound Carbon



Soaking Carbon many times
in Solutions & precipitate the
oxyde in pores

Zn & Copper — NaOH Containing arsenite, or arsenate, Na —

Lead & other Nitrates or Ites for replacing CuO -
As Sb etc | There are double Salts of Nitrites also usual Nitrates being reduced to Nitrites

Basic Phosphates

Storage Battery use Iron Sheets Corrugated 0.05 thick -
Coat by Electrolysis with $Ni(OH)_2$ by surplus of Chloride in the NaOH

then peroxidize by current after transforming to pure NaOH precisely washing - Same with the Salt & Reducing in H, This make a powerful disch rate for Epel uses Starters Cells Etc

Dont forget to try, selectively of ~~Zinc~~, Zn Hydroxide precipitated in Every solution & mixture of solutions & also organic salts in sol

Peroxide lead is only
slightly sol in NaOH

Make a cell with Buffer
partition dividing the
Electrolyte, fill the
Buffer with flow Zinc
to prevent Oxy Compound
reaching the working
Zinc Electrode

This is a good general
Idea

Stable Cupric & the basic Salt

$7CuO-2SO_3-5H_2O$

Prepare by digesting basic Copper sulfate

$7CuO-2SO_3-15H_2O$

with 10% Potassium hydroxide solution — Washing precip with Cold water & alcohol & Dry at 100° Cent Light blueish green color

The basic sulfate itself is obtained by action of 50 CC of 2 N Sodium hydroxide on a sol of 5 grams of Cupric Sulphate in 200 CC of water boiled & dried at 100° Cent.

Dark deposit on Cu hydrox
ignite & press -

Try Sulfonic acid salts.
for desulfuring Zn hydrox -
such as Benzene sulfonate
Soda etc NH4 etc + other
sulfonates - + Basic Sulfonate

Try the Azo compounds for
Oxygen Corrosion

Artificial Sulphide of
Lead made as an anode
put in water (having
small quantity acid)
say H_2SO_4 less than 1%
or a salt. The sulfide by
current is oxidized + then
made Pb peroxide electrical

Change of charge the PbO_2 protects the sulfide from the acid until whole is peroxide -

Barium ferrate not decomp by Cold H_2SO_4 - might use with amalgamated Zinc

When excess of CCl & NaClO Chlorate is added to Ammoniacal sol of Nickel hydrox an ppt of salt is precipitated. They use this to remove Ni from commercial $AsCl_3$ containing Fe Zn Co etc which are not affected -

When solutions containing
Ammonia-Cupric hydrate
or Hydrochlorate with
Solution of Iron Chloride
Peroxide of Copper
deposited on Anode

Ignited Antimonate of
Potash not sol in alkali
ditto Antimonate of Cobalt
ditto Antimonate of Copper
$CuO, Sb_2O_5 \times aq$

gummy Antimonate of
Potash - precipd by
Chl Ammonium sol -
(Lechemoke)

"Insol Antimonate Potash"
sol in boiling aq Caustic
Potash, precipitd again on
cooling. The traces are
precipitd by a sol Potash
salt,

Notebook Series -- Notebooks by Edison
Notebook, N-18-10-07

This notebook was used by Edison and an unidentified experimenter during October 1918. At the beginning of the book is a table "showing composition of cylinders." The remainder of the book contains descriptions of cylinders for chalk telephones prepared with various compounds. Inserted into the book are several loose pages relating to the same topic. The front cover is labeled "Chalk Telephone." The book contains 196 numbered pages, some of which are blank, and an index on pages 180-181. The index has been filmed first.

80183

Sorce Co.,
MFG. STATIONERS,
96 JOHN ST.
AND
19 PLATT ST.

CHALK TELEPHONE

INDEX - - - - - Page 180

Brooms figured page 160. - table - p. 162
Notes " 170.

INDEX

INDEX

Material	Page
Blanc Fix	31
China Clay	33
Kieselghur	35
Rottenstone	37
Lithopione	39
Tungstic Acid	41
Strontium Oxide	43
Iron Oxide from Muffle	45
" " from Roasting Oxalate	47
Barium Carbonate	49
Magnesium Silicate	51
Cadmium Oxide from Carbonate	53
Nickel Oxide from roasting Oxalate	55
Calcium Tungstate	57
Uranate of Sodium, Yellow Hydrated	59
Bismuth Oxide from Subcarbonate	61
Lithium Phosphate	63
Silica	65
Alumina Hydrate	67
" " and Strontium Carb. Mixture	69
Antimonic Acid	71
Barium Antimoniate	73
Magnesium Ammonium Phosphate	77
Molybdic Acid	79
Sodium Antimoniate	75
Ferric Hydroxide	81

Calcium Hydroxide	83
Magnesium Hydroxide	83
Stannous Hydroxide	85
Zinc "	85
Bismuth "	87
Mercuric "	87
Lead "	89
Cadmium "	89
Manganic "	91
Cobaltic "	91
Nickel "	93
Cupric "	93
Ferrate of Barium	95
Barium, Ferrate of	95
Strontium Carbonate	95
Chromic Hydroxide	97
Yellow Hydrated Uranate of Sodium	59
Strontium Carb. and Alumina Hydrate (Mixture)	69

TABLE SHOWING COMPOSITION OF CYLINDERS.

1	2	3	4	5	6	7	8	9	10
Material	Quantities to make one cylinder 23/32" diameter and about 7/16" long.				Percentages.		Pressure (atm)	Length	Remarks.
	Material grams	Water c.c.	KOH Solution (2% sol.) c.c.	Material %	Water %	2% KOH Soln %		(inches)	
~~1 C.P. Zinc Chlinchfield Products Corporation, Pittsburgh, Penn.~~	~~7.5~~	~~—~~	~~—~~	~~100~~	~~—~~	~~—~~	~~600~~	~~1/2~~	~~N.G. too soft Can't use, see (#18)~~
2 China Clay Lion Brand C.B. Chystal N.Y.	5.25	—	—	100	—	—	200	1/2	
3 Kieselguhr BCA 2.4	2.5	1.2	—	67.6	32.4	—	300	15/32"	
4 Pottstone (Smoke) Dupton Chemical Co.	4.5	—	—	100	—	—	200	27/64"	
~~5 Litho (Pink) Hucks Pigment and Chemical Co.~~	~~7.5~~	~~—~~	~~—~~	~~100~~	~~—~~	~~—~~	~~200~~	~~29/64~~	~~too rough See #27~~
~~6 Acid Tungstic C.P.~~	~~7.65~~	~~—~~	~~—~~	~~100~~	~~—~~	~~—~~	~~200~~	~~7/16~~	~~See #26~~
~~7 Strontium Oxide from Nitrate Fisher Chemical~~	~~4.15~~	~~—~~	~~—~~	~~100~~	~~—~~	~~—~~	~~200~~	~~7/16~~	~~too rough See #3~~
~~8 Zinc Oxide from Nitrate Fr 4625 28~~	~~6.5~~	~~0.5~~	~~—~~	~~92.8~~	~~7.18~~	~~—~~	~~200~~	~~29/64~~	~~too rough~~
~~9 Zinc Oxide made from Oxalate (Fr 2-8)~~	~~6.5~~	~~0.9~~	~~—~~	~~92.06~~	~~9.12~~	~~—~~	~~200~~	~~7/16~~	~~too rough See #35~~
~~10 Barium Carbonate~~	~~7.1~~	~~0.2~~	~~—~~	~~97.24~~	~~2.76~~	~~—~~	~~300~~		See No. 20
~~11 Magnesium Silicate~~	~~5.3~~	~~0.4~~	~~—~~	~~93.2~~	~~6.8~~	~~—~~	~~300~~		See #27 Can't moisten—stiffness.
12 Cadmium Oxide from Carbonate	10.2	—	—	100	—	—	300	c.k.	Can't Machine—too soft.
~~13 Nickel Oxide from Basic Carbonate~~	~~7.6~~	~~0.4~~	~~—~~	~~94.~~	~~—~~	~~—~~	~~300~~		
14 Calcium Tungstate $CaWO_4$	6.2	0.3		95.39	4.61		250		
15 Yellow Hydrated Uranate of Sodium	7.05	0.4	—	94.63	5.37	—	300		
16 Bismuth Oxide from Sub Carbonate	12.3	0.3	—	97.62	2.38	—	300		
17 Lithium Phosphate $Li_3PO_4 \frac{1}{2} H_2O$	3.3	0.2	—	94.3	5.7	—	300		
~~18 Black Tin~~	~~7~~	~~0.2~~	~~—~~	~~97.~~	~~2.7~~	~~—~~	~~300~~	~~c.k.~~	~~too soft~~ See #21
~~19 Lith~~	~~4.4~~	~~0.4~~	~~—~~	~~91.~~	~~8.3~~	~~—~~	~~200~~	~~7/16~~	See #31+32
~~20 Barium Carbonate~~	~~8.15~~	~~0.25~~	~~—~~	~~97.02~~	~~2.98~~	~~—~~	~~400~~		See 33+34

TABLE (continued)

	1	2	3	4	5	6	7	8	9	10
	Material	Quantities to make one cylinder			Percentages			Pressure (atm)	Length	Remarks.
		Material gms	H_2O cc.	20% Solution KOH cc.	Material %	H_2O %	20% Solution KOH %			
	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~		
22	Lithophone 2 cylinders 1 cyl.	17 7.9	.9 .4	—	95.15	4.82	-	400		
23	Strontium Oxide	5.2	0.3		94.55	5.45		300		
24	~~Zinc Oxide made from Oxalate~~	~~[illegible]~~	~~[illegible]~~					~~[illegible]~~		~~[illegible]~~
25	Alumina Hydrate	2.7	0.3		90	10		500	13/32	
26	Tungstic Acid	8.5	0.3		96.6	3.4		400	25/64	
27	Magnesium Silicate (from Mr. Dimitrie)	6.0	—	0.5	—		10% Soln 5.9	500		not baked
28	Black Fire	8	—	10% soln .5	94.1			500		Baked 4 hrs
29	"	8	—	.5				500		Baked "
30	"	8 + 7 drops Silicate				Soda Soln		500		Baked 3 hrs
31	Silica	4.4	—	10% 0.4	91.67		8.33 10% Soln	500		Baked "
32	"	4.4	+ 7 drops Silicate			Soda Soln		500		Baked 2 hrs
33	Barium Carbonate	8.2	—	10% 0.3	96.47		3.53 10% Soln	500		Baked "
34	" "	8.2	+ 5 drops Silicate			Soda Soln		500		Baked.
35	Iron Oxide from Oxalate Fe_2O_3	7.6	—	0.7 10%	91.57		8.43 10% Soln	500	13/32	Baked.
36	~~Antimonic Acid H_3SbO_4~~	~~5.0~~	~~—~~	~~0.4 10%~~				~~500~~		~~not Baked.~~ see # 49
37	Barium Antimoniate $Ba(SbO_3)_2$	5.1	—	0.4 (10%)	92.15		7.85 10% Soln	400	✓	not Baked.
38	Magnesium Ammonium Phosphate $MgNH_4PO_4 \cdot 6H_2O$	3.6	—	0.3 (10%)	92.3		7.7 10% Soln	500		Baked
39	Nickel Oxide made from Oxalate	8.9	—	0.4 (10%)	95.7		4.3 10% Soln	500		Baked
40	" " " " "	8.9	+ 6 drops Sodium			Silicate	Soln.	500		Baked.
41	Molybdic Acid	6.0	—	—	100	—	—	500		

	1	2	3	4	5	6	7	8	9	10
	Material	Quantity to make one cylinder			Percentages			Pressure	Length	Remarks.
		Material grams	H_2O cc	100% Solution KOH cc	Material	H_2O	KOH Solution	(atm)		
42	Sodium Antimonate $NaSbO_3$	6.5	—	—	100	—	—	500		
43	Alumina Hydrate	2.4			100			500		Plain - (no water, no KOH not Baked) good
44	" "	2.4			100			"		no water, no KOH. Baked 5 hours after making. (212°)
45	" "	2.3			100			"		Powder dried 5 hours at 212° before cylinder was made
46	" "	2.4			100			"		no water, no KOH heated at dull red heat after making
47	Alumina Hydrate, Strontium Carbonate } combination equal parts by weight	3.65			100			500		
48	Ferric Hydroxide	5.2		0.4	92.85		7.15 100% Soln	500		
49	Antimonic Acid	5.5	—	—	100			500		
~~50~~	~~Fullers Earth~~	~~3.3~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~500~~		
~~51~~	~~Clay-lox~~	~~5.0~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~500~~		
52	Calcium Hydroxide (#1)	3.1	—	—	100			500		
53	Magnesium Hydroxide $Mg(OH)_2$ (L.O.)	3.25	—	—	100			500		
54	Stannous Hydroxide $Sn(OH)_2$ (L.O.)	6.05	—	—	100			500		
55	Zinc Hydroxide $Zn(OH)_2$ (L.O.)	5.2	—	—	100			500		
56	Bismuth Hydroxide $Bi(OH)_3$ (L.O.)	9.1	—	—	100			500		
57	Mercuric Hydroxide $Hg(OH)_2$ (L.O.)	15.0	—	—	100			500		
58	Lead Hydroxide $Pb(OH)_2$ (L.O.)	11.0	—	—	100			500		
59	Cadmium Hydroxide $Cd(OH)_2$ (L.O.)	5.6	—	—	100			500		
60	Manganic Hydroxide $Mn_2(OH)_6$ (L.O.)	4.1	—	—	100			500		
61	Cobaltic Hydroxide $Co_2(OH)_6$ (L.O.)	5.1	—	—	100			500		
62	Nickel Hydroxide (L.O.)	6.0	—	—	100			500		

	1	2	3	4	5	6	7	8	9	10
	Material	Quantity to make one cylinder			Percentages			Pressure	Length	Remarks.
		Material grams	H_2O cc	30% Soln KOH cc.	Material	H_2O	30% Soln KOH	(atm)		
63	Cupric Hydroxide	4.3	—	—				500		
64	Ferrate of Barium	4.7	—	—				500		
65	Strontium Carbonate	6.2	—	0.4		94%	6%	400		
66	Chromic Hydroxide	3.3	—	—				500		
67	Potassium Iodide									
68	Potassium Percarbonate									
69	Sodium Tungstate									
70	Potassium Ferrocyanide									
71	Potassium Ferricyanide									
72	Sodium Molybdate									
73	Sodium Ferrocyanide									
74	Potassium Tellurite									
75	Magnesium Hydroxide made by Mu. Edison	3.9	—	—				500		
76	Magnesium Hydroxide #2 (L.O.)	2.7	—	—				500		
77	Magnesium Citrate	3.25						500		
78	" Ethyl Sulphate	3.8						500		
79	" Oxalate	4.3		0.3cc 10% KOH soln				500		
80	" Fluoride	4.1						500		
81	" Formate	4.0		0.3cc 10% Soln KOH				500		
82	" Sulphite	4.7		0.3cc. 10% KOH Soln				500		
83	" Acetate	3.3						500		

	1	2	3	4	5	6	7	8	9	10
	Material	Quantity to make one cylinder			Percentages			Pressure (atm)	Length	Remarks.
		Material grams	H_2O cc	Solution KOH cc	Material	H_2O	KOH Solution			
84	Magnesium Oxide (Light Calcined Magnesia)	3.5	—	—				500		
85	" Carbonate	3.0	—	—				500		
86	" Phosphate	4.2	—	0.2 cc 10% KOH Soln.				500		
87	Calcium Sulphide	4.2	—	0.3 cc 10% Soln.				500		
88	" Silicate	2.4	—	—				500		
89	" Arsenate	5.1	—	—				500		
90	" Oxalate	3.1	—	—				500		
91	" Chromic	6.0	—	0.3 cc 10% Soln.				500		
92	" Citrate	3.4	—	—				500		
93	" Acetate	3.8	—	0.3 cc 10% Soln.				500		
94	" Sulphate	5.0	—	0.3 cc 10% Soln.				500		
95	Strontium Antimoniate	5.5	—	—				500		
96	" Oxalate	4.7	—	0.5 cc 10% Soln				"		
97	" Fluoride	7.0	—	0.7 cc 10% Soln.				"		
98	" Sulphate	7.2		0.5 cc. 10% Soln				"		
99	" Salicylate	4.5		0.2 cc. 10% Soln				"		
100	" Borate	3.8		0.6 cc. 10% Soln.				"		
101	Barium Hydroxide	5.3	—	—				"		
102	" Borate	4.0		0.5 cc. 10% Soln				"		
103	" Arsenate	7.8		0.4 cc. 10% Soln				"		
104	" Phosphate	8.3		0.5 cc 10% Soln.				"		

	1	2	3	4	5	6	7	8	9
	Material	Quantity to make one cylinder			Percentages			Pressure (atm)	Remarks.
		Material gms	H_2O. cc.	KOH soln. cc.	Mat. %	H_2O. %	KOH %		
105	Iron Citrate	4.0		0.1 2%				500.	
106	" Borate (Ferric)	5.2		0.4 (10)				"	
107	" Sulphide (Empiro Reagent)	9.0		0.6 (10)				"	
108	" Tannate (Ferrum)	4.5		0.6 10%				"	
109	" Carbonate (p.r.c)	5.9		0.5-10%				"	
110	" Phosphate (Ferrous true)	4.4		0.5-10%				"	
111	Fe - by H - made from Am Fe SO_4 crystals. no H_2O	7.9		0.8-10%				"	
112	Iron Oxalate (Ferric)	5.7		0.4-10%				"	Can't make it stick to make bottom up to 500 atmos. pressure
113	Aluminum Oxide (pure)								
114	" Chromate	2.7		0.5 (2%)				500	
115	~~Alumin Sulphate c.p.~~								Deliquescent
116	Zinc Oxalate	6.5		0.6 (2%)				500	
117	" Carbonate	6.1		0.5 (2%)				500	
118	~~" Bromide~~								Deliquescent
119	" Oxide	9.5		0.8 (10%)				500	
120	" Sulphate	5.4		0.5 (2%)				500	
121	Mercury Oxide (Red)	17.5		0.6 (10%)				500	
122	Nickel Citrate	5.2		0.3 (2%)				500	
123	" Oxalate	4.4		0.35 (2%)				500	
124	" Ammonium Sulphate	4.7		0.3 (10%)				500	
125	Tin Oxide, Black (Stannous)	9.7		0.6 (10%)				500	

	1	2	3	4	5	6	7	8	9
	Material	Quantity to make 1 cylinder			Percentages			Pressure	Remarks.
		material grms	H_2O cc	10% H_2O_2 soln. cc.	Heat	H_2O	10% H_2O_2 soln.	(atm)	
126	Manganese Acetate	3.9		0.3(2%)				500	
127	" Black Oxide	7.15		0.5(2%)				500	
128	" Carbonate	4.9		0.6(2%)				500	
129	" Borate	5.9		0.5(2%)				500	
130	Copper Oxide	9.5		0.7(2%)				500	
131	" Carbonate	6.5		0.5(2%)				500	
132	Lithium Carbonate C.P.	4.0		0.8(10%)				500	
133	Lead Oxide (PbO) yellow	18.5		0.6(10%)				500	
134	" Phosphate	10.8		0.45(10%)				500	
135	" Sulphate (Highest Purity)	12.6		0.8(10%)				500	
136	" Nitrate	11.2		0.25(10%)				500	
137	" Peroxide	14.9		0.8(2%)				500	
138	Cobalt Sulphate	5.1		0.2(2%)				500	
139	Bismuth Oxychlorate	12.3		0.9(2%)				500	
140	" Sub Carbonate	12.1		0.8(2%)				500	
141	Strontium Arsenate	7.5		0.4(2%)				500	
142	Magnesium Borate	3.4		0.25(2%)				500	
143	Calcium Ferrocyanide	4.4		0.4(2%)				500	
144	Colloidal Ferric Hydroxide	6.6	—	—				500	
145	Anthracene (pure)	3.4	—	—				500	ORGANIC.
146	P. Amido Phenol	2.9	—	—				500	
147	P. Amido Phenol Hydrochloride	3.2	—	—				500	

	1	2	3	4	5	6	7	8	9
	Material	Quantity to make one cylinder			Percentages			Pressure atm.	Remarks.
		Material gms	H_2O c.c.	KOH soln. c.c.	Mat.	H_2O	KOH soln.		
148	Para Phenylene Diamine, Recryst from Benzol M.P. 140°C.	2.9	—	—				500	ORGANIC
149	Benzidine	3.4	—	—				500	
150	Benzidine Sulphate	3.2	—	—				500	
151	Naphthalene	3.2	—	—				500	
152	Copper Oxide	9.7	—	0.6-2%				750	
153	Strontium Oxalate	4.5	—	—				750	
154	" "	4.5	—	—				1000	
155	Calcium Silicate	2.8	—	—				750	
156	" "	2.8	—	—				1000	
157	Calcium Oxalate	3.3	—	—				750	
158	" "	3.3	—	—				1000	
159	Strontium Carbonate	6.25	—	0.4-2%				500	
160	" "	6.7	—	0.3-2%				750	
161	" "	7.0	—	0.3-2%				1000	
162	Colloidal Chromic Hydroxide	4.6	—	—				500	
163	Aluminum Acetate								
164	" Fluoride								
165	" Oxide								
166	Potassium Alum								
167	Sodium Alum								
168	Antimony Oxide								
169	" Sulphide (tri)								

	1	2	3	4	5	6	7	8	9
	Material	Quantity to make one cylinder			Percentages			Previous	Remarks.
		Material gms	H_2O cc.	KOH soln. cc.	Material	H_2O	KOH soln		
170	Antimony Sulphide (pentas)								
171	Cadmium Oxalate								
172	" Sulphate								
173	" Phosphate								
174	" Carbonate								
175	Cobalt Oxide								
176	" Sulphide								
177	Copper Oxalate								
178	Lead Chromate								
179	" Oxalate								
180	Mercuric basic Carbonate								
181	" Oxalate								
182	Mercurous Chloride (Calomel)								
183	Molybdenum Oxide								
184	Nickel Carbonate								
185	Silver Oxide								
186	" Oxalate								
187	" Sulphate								
188									
189									
190									
191									

BLANC FIX

Chlinchfield Products Corporation, Johnson City, Tenn.

1 – 7.5 gms. – 200 atmos. – too soft can't use. N.G.
2 – 7 gms. – .2 cc of 20% KOH Sol. 300 at. too soft. N.G.
3 – 8 gms. .5 cc of 10% KOH Sol. 500 at.
4 – 8 " " " " " " Baked 4 hrs.
5 – 8 " + 7 drops Silicate of Soda Solution Baked 4 hrs.
Numbers 1 and 2 could not be machined – would not hold together.

CHINA CLAY

Lion Brand CB Chrystal N.Y.

1— 5.25 gms — 200 atmos.

2— 5.25 gms — 300 atmos. (Better)

KISSELGHUR

Building 24

2.5 grams + 1.2 cc H_2O 300 atmos.

(67.6% + 32.4% H_2O)

ROTTENSTONE
(SMOKE)

Keystone Chemical Co.

4.5 grams — — 200 atmos.

Might be better to increase pressure.

LITHOPHONE
(Panolith)

Krebs Pigment and Chemical Co.

7.5 gms — 200 atmos. — Soft. N.G.

7.9 gms + 0.4 cc. H_2O (4.82%) 400 atmos.

TUNGSTIC ACID

C.P.

8.5 gms + 0.3 cc. H_2O (%) 400 atmos.

STRONTIUM OXIDE

hydr. cryst. C.P. Eimer and Amend.

5.2 gms + 0.3 cc. H_2O (5.45 %) 300 atmos.

IRON OXIDE

FROM MUFFLE Fe 4625 - 28

IRON OXIDE

FE_2O_3 made from Roasting Oxalate

7.6 gms + 0.7 cc of 10% Solution KOH — 500 atmos.
Baked 2 hours at 212°

BARIUM CARBONATE

7.1 gms + 0.2 cc. water 300 atmos NG - won't stick together

8.15 gms + 0.25 cc 2% KOH solution 400 atmos.
Can't machine - won't stand more moisture

8.2 gms + 0.3 of 10% KOH Solution 500 atmos.
Baked 2 hours at 212

8.2 gms + 5 drops Sodium Silicate Solution 500 atmos.
Baked 2 hours at 212

None of above can be machined.

MAGNESIUM SILICATE

5.5 gms + 0.4 cc. H_2O — 300 atmos.
seemed rough.

6.0 gms + 0.5 cc. of 2% KOH solution — 500 atmos.

Cadmium Oxide

From Carbonate

10.2 grams — 300 atmos.

NICKEL OXIDE

from Roasting Oxalate – L.O.

7.6 gms + 0.4 cc. H_2O — 300 atmos.
very soft. N.G.

8.9 gms + 0.4 cc of 1090 KOH Solution — 500 atmos.
Heated at 212° for 3 hours.

8.9 gms + 6 drops Sodium Silicate Solution
Heated at 212° for 3 hours.

CALCIUM TUNGSTATE

$CaWO_4$ L.O.

6.2 gms + 0.3 cc H_2O —— 250 atmos.

YELLOW HYDRATED URANATE OF SODIUM

7.05 gms + 0.4 cc H_2O —— 300 atmos.

1 BISMUTH OXIDE

from Sub carbonate

12.3 gms + 0.3 cc. H_2O —— 300 Atmos.

LITHIUM PHOSPHATE

$Li_3PO_4 \frac{1}{2} H_2O$ L.O.

3.3 gms + 0.2 c.c. H_2O — 300 atmos.

SILICA

4.4 gms + 0.4 cc of 2% KOH Soln — 500 atmos.
Very Soft - N.G.

4.4 gms + 0.4 cc of 10% KOH soln — 500 atmos.
Baked 3 hours at 212°

4.4 gms + 7 drops Silicate of Soda soln. — 500 atmos.
Baked 3 hours at 212°

ALUMINA HYDRATE

2.7 gms + 0.3 cc. H_2O — 500 atmos.

2.4 gms — 500 atmos. — plain

2.4 gms — 500 atmos. Heated for 5 hours at 212°.

2.3 gms — 500 atmos. — Powder heated 5 hours at 212° before being pressed.

2.4 gms — 500 atmos. heated for 3 hours at 212° F then at from 300 to 350 degrees F for one hour. This heating cracked the cylinder. It was then powdered up again and pressed into a cylinder again at 500 atmospheres, using no water or KOH.

MIXTURE

ALUMINA HYDRATE & STRONTIUM CARBONATE

Equal Parts by weight

3.65 gms — 500 atmos.

ANTIMONIC ACID

H_3SbO_4 L.O.

~~5.6 gms + 0.4 cc 10% KOH soln. = 500 atmos.~~

5.5 gms at 500 atm.

BARIUM ANTIMONIATE

$Ba(SbO_3)_2$ L.O.

5.1 gms + 0.4 cc. of 10% KOH soln. 400 atmos.

SODIUM ANTIMONIATE

$NaSbO_3$ L.O.

6.5 gms dry 500 atmos.

MAGNESIUM AMMONIUM PHOSPHATE

$MgNH_4PO_4 \cdot 6H_2O$ L.O.

3.6 gms + 0.3 of 10% soln. KOH — 500 atmos

MOLYBDIC ACID

H_2MoO_4, Precipitated L.O.

6.0 grams dry at 500 atmos

FERRIC HYDROXIDE

Precipitated, Washed, Dried Room Temp.

5.2 grams + 0.4 cc of 10% KOH solution 500 atmos.

CALCIUM HYDROXIDE

$Ca(OH)_2$

3.1 gms at 500 atm.

MAGNESIUM HYDROXIDE

$Mg(OH)_2$ ~~L.C~~ good. L.O.

#1 Precipitated Cold, then washed by decantation, filtered, dried in air
3.25 gms at 500 atm.

#2

#3 Made by Mr. Edison
3.9 gms at 500 atm.

STANNOUS HYDROXIDE

$Sn(OH)_2$ L.O.

6.05 gms at 500 atm.

ZINC HYDROXIDE

$Zn(OH)_2$ L.O.

5.2 gms at 500 atm.

BISMUTH HYDROXIDE

$Bi(OH)_3$ L.O.

9.1 gms at 500 atm.

MERCURIC HYDROXIDE

$Hg(OH)_2$ L.O.

15.0 gms at 500 atm.

LEAD HYDROXIDE

$Pb(OH)_2$ L.O.

11.0 gms at 500 atm.

CADMIUM HYDROXIDE

$Cd(OH)_2$ L.O.

5.6 gms at 500 atm.

MANGANIC HYDROXIDE

$Mn_2(OH)_6$ L.O.

4.1 gms at 500 atm.

COBALTIC HYDROXIDE

$Co_2(OH)_6$ L.O.

5.1 gms at 500 atm.

NICKEL HYDROXIDE

6gms at 500 atm.

CUPRIC HYDROXIDE

4.3 gms at 500 atm.

FERRATE OF BARIUM

4.7 gms at 500 atm.

STRONTIUM CARBONATE

6.2 gms + 0.4 cc. 2% KOH Soln.
94% 6%

CHROMIC HYDROXIDE

3.3 gms at 500atm

Dia. of Ram = 5" = D_R

" " Plunger = $\frac{23}{32}$" = D_P (= 0.71875")

```
  71875
  71875
 359376
503125
575000
 71875
503125
.5166015625 = (0.71875)²
```

Press on Ram = Press. on plunger × $\frac{\text{area of Plunger}}{\text{area of Ram}}$

= Press on plunger × $\frac{D_P^2}{D_R^2}$

For 100 atmospheres on plunger = 1500#/□" on plunger

#/□" on Ram (gauge) = $1500 \times \frac{0.5166015625}{25}$

= 30.9960937500

say 31 #/□" on gage.

Comparison of Gages.

0-200 lb/□" gauge -

0-1000 lb/□" gauge -

200# gauge	1000# gauge	200# gauge	1000# gauge
0	20	100	122
10	33?	110	137
20	41	120	147
30	52	130	158
40	62	140	170
50	72	150	180
60	85	160	191
70	95	170	200
80	102	180	210
90	115	190	220
		200	232

Plotting curve and taking two points for which pressure on 200# gage = 0 and 260#/□" and pressure on 1000# gage = 20#/□" and 296#/□" respectively,

Pressure #/□" on 1000# gage = $\frac{69}{65}$ × (#/□" on 200# gage) + 20

1000# gauge made by John Robertson & Co. Brooklyn N.Y.
No. 3982149 (Schaeffer & Budenberg N.Y. Trade Mark)
Range 0-200.

200# gauge made by T. Shriver & Co., Harrison N.J.
Marked U.S. Gauge Co. N.Y.

Pressure on Plunger ($\frac{29}{32}$" dia)			Reading on gauge	
atmospheres	#/□"	tons/□"	200# gauge	1000# gauge
100	1500	0.750	31	
150	2250	1.125	46.5	
200	3000	1.500	62	
250	3750	1.875	77.5	
300	4500	2.250	93	
350	5250	2.625	108.5	
400	6000	3.000	124	
450	6750	3.375	139.5	
500	7500	3.750	155	
550	8250	4.125	170.5	
600	9000	4.500	186	
650	9750	4.875	201.5	224
700	10500	5.250	217	250
750	11250	5.625	232.5	267
800	12000	6.000	248	284
850	12750	6.375	263.5	300
900	13500	6.750	279	316
950	14250	7.125	294.5	333
1000	15000	7.500	310	349
1050	15750	7.875	325.5	366
1100	16500	8.250	341	382
1150	17250	8.625	356.5	399
1200	18000	9.000	372	415
1250	18750	9.375	387.5	431
1300	19500	9.750	403	448

Contrast these on this gauge — must use 1000# gauge

For identification of gauges see bottom page 161.

Oct. 7, 1918

Blank Fire # 18 – went to pieces
✓ China Clay # 2
✓ Kieselguhr # 3
✓ Rottenstone # 4
✓ Tungstic Acid # 6 – too rough
✓ Strontium Oxide # 7 – too rough
✓ Calcium Tungstate # 14
✓ Lithium Phosphate
✓ Yellow Hydrated Uranate of Sodium
✓ Cadmium Oxide
✓ Bismuth Oxide
✓ Magnesium Silicate

1796

Hydraulic Ram

Ram 5" dia
Mould $\frac{3}{4}$" - $\frac{1}{32}$" dia. $\frac{23}{32}$"

[ITEMS(S) FOUND IN BOOK]

(200# gauge assumed to be correct)

Pressure on Plunger .5"			Gauge Reading	
Atmospheres	lb. per sq. in.	Tons per sq. in.	on 200 lb gauge	on 1000 lb gauge
100	1500	.750	31	
150	2250	1.125	46.5	
200	3000	1.500	62	
250	3750	1.875	77.5	
300	4500	2.250	93	
350	5250	2.625	108.5	
400	6000	3.000	124	
450	6750	3.375	139.5	
500	7500	3.750	155	
550	8250	4.125	170.5	
600	9000	4.500	186	
650	9750	4.875	201.5	224
700	10500	5.250	217	250
750	11250	5.625	232.5	267
800	12000	6.000	248	284
850	12750	6.375	263.5	300
900	13500	6.750	279	316
950	14250	7.125	294.5	333
1000	15000	7.500	310	349
1050	15750	7.875	325.5	366
1100	16500	8.250	341	382
1150	17250	8.625	356.5	399
1200	18000	9.000	372	415
1250	18750	9.375	387.5	431
1300	19500	9.750	403	448

← These cannot be read on this gauge — use 1000#/□" gauge →

200# gauge - made by T. Shriver & Co., Harrison N.J. Trade mark U.S. Gauge Co. N.Y. Range 0-200#/□".

1000# gauge - made by John Robertson & Co., Brooklyn, N.Y. No. 3982149 - Trademark Schaeffer & Budenberg N.Y. Range 0-1000#/□"

Oct. 7, 1918

[ITEMS(S) FOUND IN BOOK]

2 al Hydrox plain

2 al Hydrox plain then after made put in oven to dry for several hours at 212 —

2 made from alhydrox the powder of which has been dried at 212 for several hours —

2 being a mixture of 1/2 alhydrox & 1/2 Carb stronia not dried

[ITEMS(S) FOUND IN BOOK]

Precipitated Chalk
Fuller's Earth
Terre-Blanche
Zinc Oxide
Claylox
Zinc Carbonate
" Resinate
" Sulphate
Magnesium Carbonate
White Lead
Red "
Litharge
Rouge - Red Oxide of Iron
Sodium Bicarbonate

[ITEMS(S) FOUND IN BOOK]

①

Crucible or Tool Steel

Elastic Limit, Tension 180,000

Modulus of Elasticity 30,000,000

[ITEMS(S) FOUND IN BOOK]

②

$\frac{23}{32} = 0.72''$ dia

0.72
0.72
144
504
0.5184

.1296
$\frac{\pi}{4} \times 0.5184$

3.1416
.1296
188496
282744
62832
31416
0.40715136

5" dia.

$\frac{\pi}{4} \times .25$

3.1416
6.25
7879
188496
19.6375 □"

For 10 Datmos. = 1500 #/□" on die.

pressure on 5" diaphram

$\frac{0.40715136}{19.6375} \times 1500 = 31.1$ #/□"

[ITEMS(S) FOUND IN BOOK]

(3)

```
 40.715136
        15
 203575680
 40715136
 610.72704 0

19.6375) 610.727040 ) 31.1#/□"
         589125
          216020
          196375
           196454
```

[ITEMS(S) FOUND IN BOOK]

(4)

area die plunger = 0.407 □"

Elastic Limit. (tension) = 180,000 #/□"

Therefore to reach E.L.

force on plunger

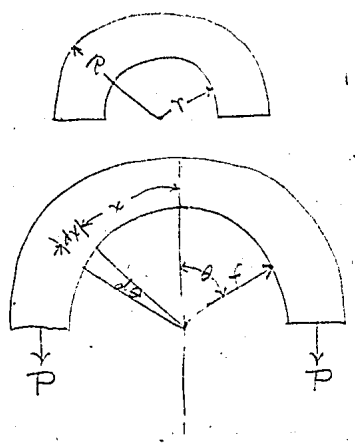
= 0.407 × 180,000 = 73,400 #

on gauge

$$\frac{180,000}{1500} \times 31.1 = 3730 \ \#/\square''$$

or = $180,000 \times \frac{0.407}{19.638} = 3730 \ \#/\square''$

[ITEMS(S) FOUND IN BOOK]



length = L inches

R+r in inches.

Stress inside = f lbs. per sq. inch.

force on infinitesimal area = $f\,dA = f\,dx\,L = dF$

Now $dx = r\,d\theta$

Vertical component of $dF = dF\cos\theta$

$= fLr\cos\theta\,d\theta$

Summing up

Vertical comp. $F = \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} fLr\cos\theta\,d\theta = fLr\left[\sin\theta\right]_{-\frac{\pi}{2}}^{+\frac{\pi}{2}}$

$1-(-1)$

$= 2fLr$

[ITEMS(S) FOUND IN BOOK]

Then $2fLr = 2P$

$fLr = P$

Stress in iron $= \frac{P}{A} = \frac{P}{L(R-r)}$

So that

$\underline{\text{stress in iron}} = \frac{fLr}{L(R-r)} = \frac{fr}{(R-r)}$.

[ITEMS(S) FOUND IN BOOK]

(7)

Elastic Limit Tool Steel = 180,000#/□"

to return to elastic limit

$$f\frac{r}{R-r} = 180{,}000$$

$$f = 180{,}000 \times \frac{R-r}{r}$$

$$R = \frac{1}{2} \times 3\tfrac{3}{4} = 1.875$$

$$r = \frac{1}{2}\left\{\begin{array}{l} 1\frac{21}{32} = \frac{1.656}{2} = 0.828 \\ \text{or} \\ 1\frac{3}{4} = 0.875 \end{array}\right\}$$

R-r
1.875
.828
1.047

1.875
.875
1.00

R-r	r = .828
.1263	
.1141	r = .875

$$f = 180{,}000 \times \frac{1}{.875}$$

$$= 206{,}000$$

[ITEMS(S) FOUND IN BOOK]

(8)

Say Max length cylinder = 1"

area = $\pi \times \frac{23}{32} \times 1$ = 2.26 sq inches.

Supposing stress transmitted equally in all directions,

total force = 2.26 × 206,000

=

Minimum length = $\frac{1}{4}$"

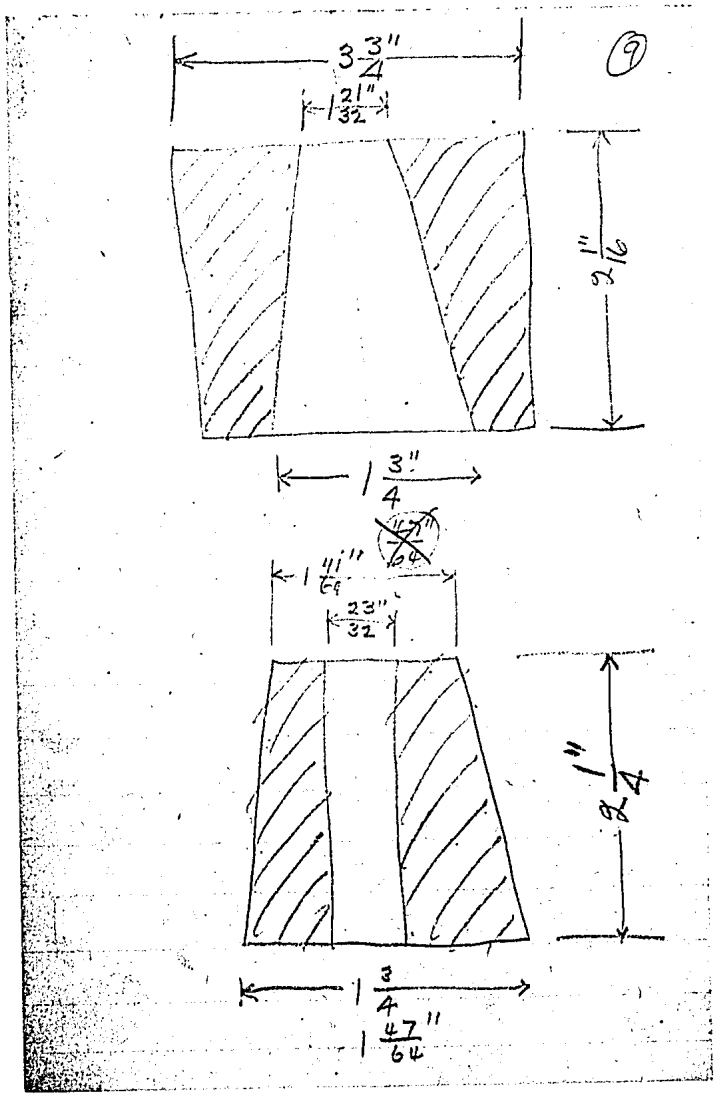
area = $\pi \times \frac{23}{32} \times \frac{1}{4}$ = 0.565

total force = 0.565 × 206,000 = 117,000 #

#.

Max Stress = 206,000 #/□"

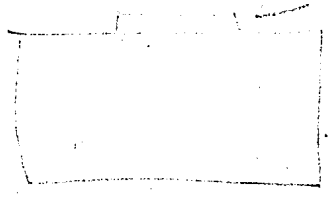
[ITEMS(S) FOUND IN BOOK]



[ITEMS(S) FOUND IN BOOK]

(10)

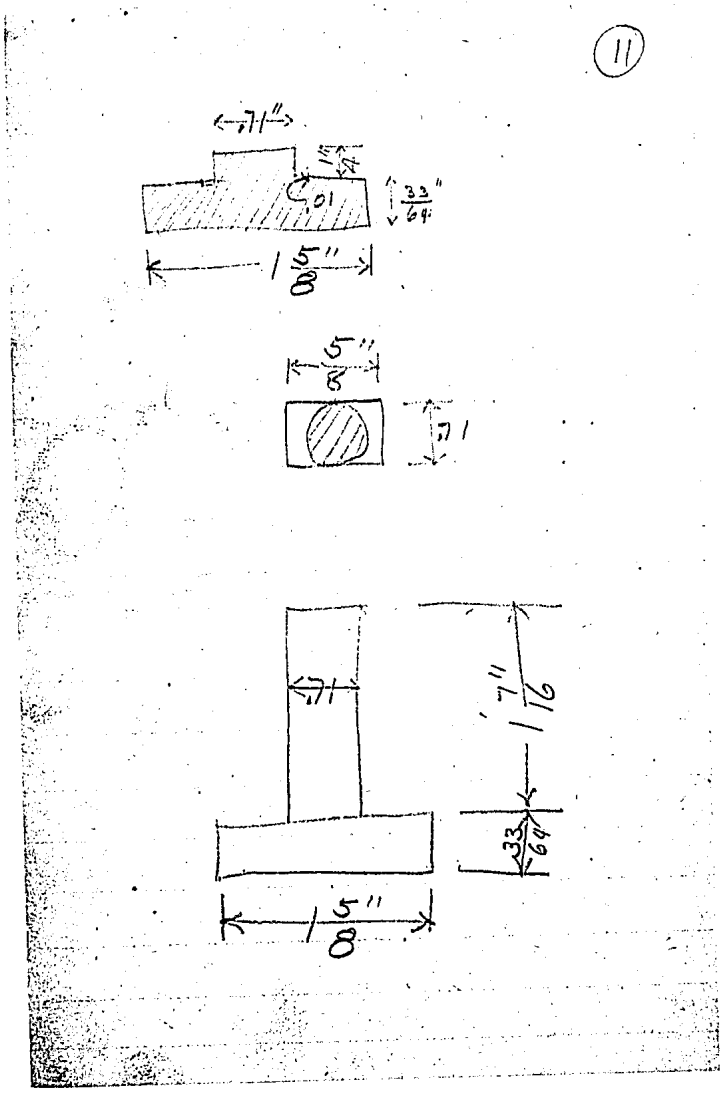
½ (−)



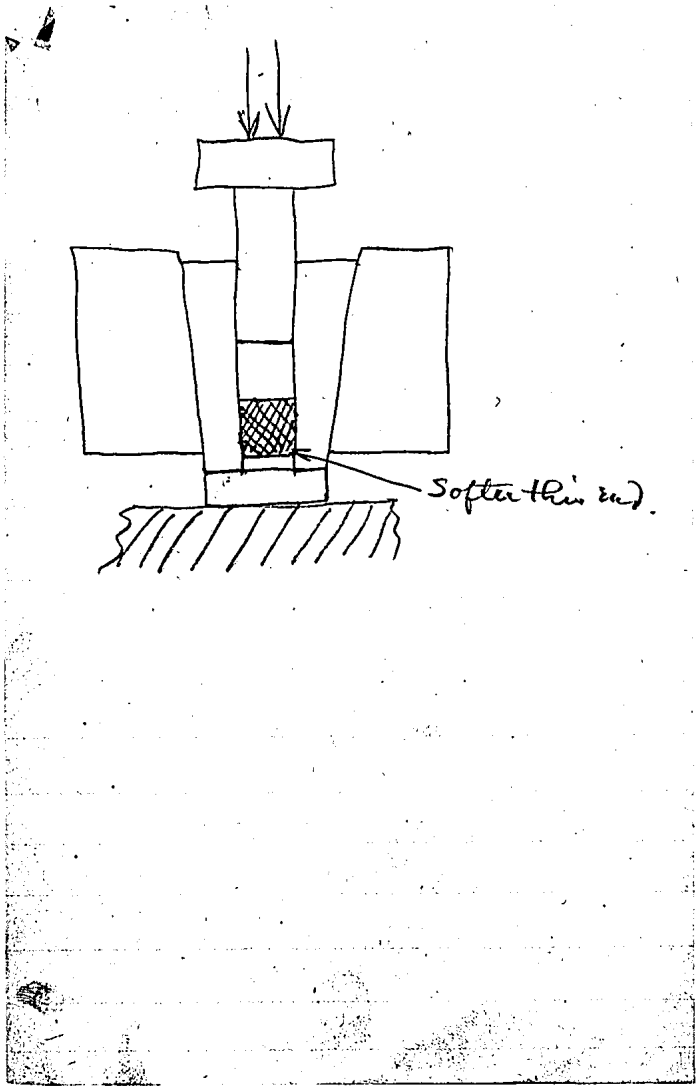
$$f = f_0 \times \frac{R - r}{r} = f_0 \left[\frac{R}{r} - 1 \right]$$

r inc – f decrease.

[ITEMS(S) FOUND IN BOOK]



[ITEMS(S) FOUND IN BOOK]



Notebook Series -- Notebooks by Edison
Notebook, N-18-11-03

This notebook was used by Edison in November 1918 in connection with work performed for the U.S. Navy during the World War I. Included are notes on acoustical experiments with various resonators, along with notes taken from the works of Herman von Helmholtz, Alfred M. Mayer, and other published sources. Some of the experiments were performed on the lawn at Glenmont, Edison's home in Llewellyn Park, and others in various buildings at the West Orange laboratory. One entry contains a speculation by Edison that his deafness gives him an advantage in hearing changes in the volumes of sounds. The entries indicate that William A. Hayes, Sherwood T. (Sam) Moore, and Frederick P. Ott assisted on some of the experiments. The pages are unnumbered. Approximately 50 pages have been used.

Bad	good
27	42
50	57
31	86
86 —	42
28	

43 — 86

16 $\frac{1}{16}$

16 — 16

256

126

$\frac{3}{16}$ | $\frac{257}{853}$ — (.534"

$\frac{5}{16}$ | $\frac{257}{514}$ (3.21"

$\frac{7}{16}$ | $\frac{257}{367}$ (2.29"

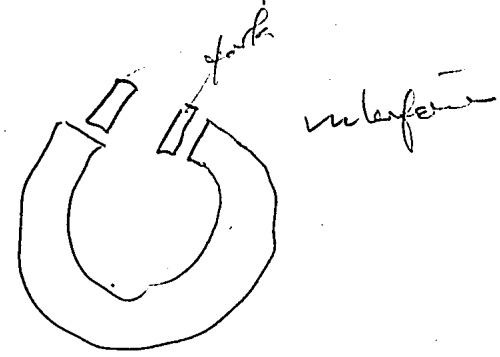
$\frac{9}{16}$ | $\frac{257}{2.8}$

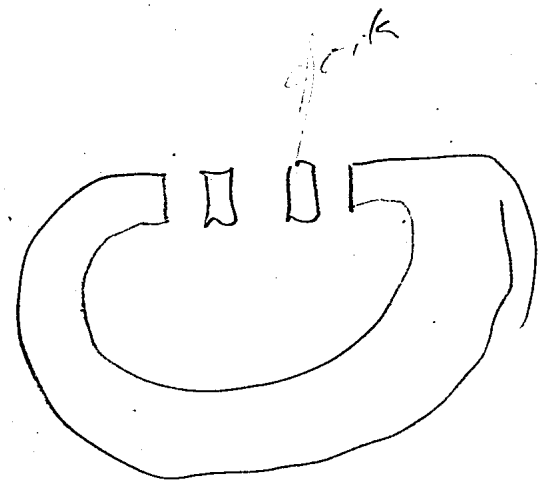
75428
Office Co.,
MFG. STATIONERS,
96 JOHN ST.
AND
19 PLATT ST.
NEW YORK

7°

Resonators

2 Resonators (Closed)
when placed at right
angles to each
other interfere when
Qracking from a
Tuning fork
because of of phenomena





in phase gives double loudness of an open tube

its the waves that dont go in the tube that is heard

Kane 251

July to Dec phil mag 1841 —

No sound no matter how intense
Can diminish or obliterate the
sensation of a concurrent sound
which is lower ~~the~~ in pitch.

(1 E) high notes sound dont
prevent hearing low notes
sounds — Mayer 1876 Phil Mag
503.

Does a strong low obliterate a weak high

~~I gave to the~~

Kundt says VE sound
~~[illegible]~~ ½ atmos
pressure in a tube of
glass. of 2½ atmos is
4 meter greater with
2½ atmos

the reason he says is that heat is not lost to walls of tube at 2½ atmos as fast as with 1/2 atmos,

Del Sound in soft Rubber is remarkable 30 to 60 meters second, the same rate as nerve impulses in the body -

Rayleigh think mainly loss of loudness is due to motion from the walls of the pipe

But says there are other losses,

Note we can test loss in Resonator tubes by putting in a music box & closing it light & listen outside

At perpendicular incidence short sound waves are more copiously reflected than those longer & ray reflection is more copious from large than from small surfaces

With a given 60 000 vibs
a second been perceived
yet beyond this the
the sensitive flame
acts powerfully.
Pouillon 1843 -
Phil Mag.

Hedrulez - More perfect
elasticity seems peculiarly
to favour the Continuance
of rapid vibration & are in
general more quickly
deadened by imperfect
elasticity & friction than
slower vibrations -
Thus rubber rods only give
sounds an octave from music box

Warburg obtained May 30
1870 — says rubber
tubing lasting when
long dampens out
high notes while
low notes heard OK
~~depends on diameter~~

for the same thickness of the
sides of Rubber Tubes
the enfeeblement of the tones
on Conduction Experiment
the higher ones, diminishing
~~dim~~ with an increase
of internal dia
with 2 mid tubes 1 small
dia one large put on
tone, by pinching the

found that the higher
notes pass more
readily from small tubes
than from the wider
? This is due to yielding of
the larger tubing –

(1e) just as Dolphin –
+ sound is lost to ear
by passing to our
outside

Helmholtz says softness
of tone on wood instruments
is due to this while
brass tubes not yielding
preserve all the high
harmonics + harsh stuff

with Hydrogen much longer
Resonant tubes required
Energy of vibrating mass
of H so small it
can scarcely be heard

Nov 2nd

Preliminary Expts with Rings & broken pieces hung on Saw horse & suspended by strings & struck by felt hammer

18" brass column 10" of which is a removable Extension — The 8" proper contains at Bulbous end phone disc & listening tube, at node

I move it up & down by a screw with index

Big iron ring hear at 10 7/8"
The Big lever for foot press cant get.
Small split ring - 14 1/8"
get response
Broken iron bar. hear at about 10"
The Bearing - hear nothing

I now remove the
10" Extension —

Hear at 3" 3/16 on big ring —

Small steel ring split
get it OK at 4 1/8
has 3/8 Manipu

Brass ring Can't hear
music but hear
knock at 4 5/8 =

Notice a phenomenon
just before I reach
the musical timbre
I hear the knock of the
Hammer, The musical
timbre covers from 2 to 3/8
whereas the knock covers
3 to 5 1/8

On the brass rump, 4 7/8
is loudest knock & faint music
bumper 1 at 6 5/8 get
big musical round
Can hear it over a range of
5 @ 6/8 —

Broken bar hear common
knock + music at 7"
but it has 3/4 range —

Knock slight musical at 2 7/16

Long foot press bar: hear knock
over 3 to 5 inches, + its an echo
tone varies, at one spot 1/2 long
get slight musical range —

Bearing — only knocks
over range of 1 1/2"
Nothing musical

Taking the note on 8" Column heard from brass ring, which had good musical quality I listened to diaphragm using rubber tube or also thru small brass tube stuck into top of Column, there is accurately any difference in the Volumes

Nov 3 1918 Sunday

Experiments made in Disc Research Bldg-

C 256 Vibs. Ash Can generator

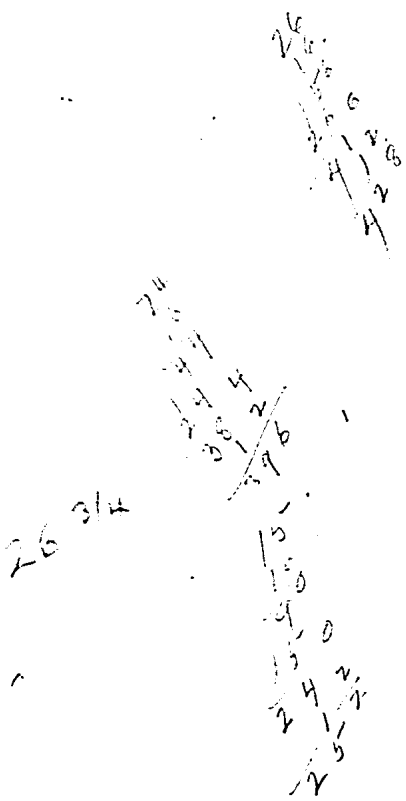
5¼ - Brass tubing, Normal opening at top 2"

All brass listening tube best,

Limit at 14½ air Column 44½ inches, (old C whistle) my cold so worse ~~As~~

then for some unknown reason Couldnt get it at 24 inches we clean out the Column as may be dirt on water Column,

1/8 above or below 14½ throws it out of tune



Best distance now is 18½ inches, something wrong somewhere my Cold or Echo interference in Room -

With the 2" glass tube air - get it at 24 3/4 - same air Column 15 3/4 - 5/8 hole.

Same but with ½" hole in Top - Column length 15 3/16 - Limit sure 26 3/4 inches.

Same but with 3/8
hole at Top —
Column — 14 11/16
Limit 35 inches —

Same but with 1/4
hole at Top — Column
14 3/16 — Limit 16 3/4"
now overlong
With other tone, 1st overlong
1 1/4 Opening — Limit 36 1/2
Column 4 3/16 —

Same but with 1 inch
Opening on Top —
Limit 32 1/2 Column
3.5/8 —

3/4
16/6
7
5 0
3/16
5

16 3/4

14
16
1/4
8
14/4
7 1/3
3
7

14 3
16
84
14
224

3 | 227 | 4.8 1/2
16 | 76
64
12 0

Dia of glass tube inside 2 5/16 —

Dome with 3/4 Opening at Top. — Limit 29 3/4 —

Column 2 13/16

ditto 5/8 Limit 28 1/2

Column 2 3/8

ditto 1/2 Limit 28 1/4

1 15/16 -

ditto 3/8 - Limit 19 1/2

1 3/8 -

We now go back to fundamental
tone = $1\frac{1}{4}$" opening at Top.
Cant get at foot opening

ditto. 1" Top Cant get

ditto 3/4 Hole - Limit $16\frac{1}{4}$
$15\frac{1}{4}$ Column -

ditto 5/8 - Hole 27 3/4 limit
Column 15 3/4

With 5/8 hole & put on a
3" long 5/8 pipe Cant get
Either fundamental
or overtone -

Now have 1½" hole on top
put 00z diaphm over
hole, too weak to get
either fundamental or
overtone –

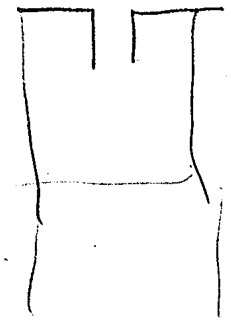
Brass, Brass Res – 2"
5/8 Hole top –
Column 16¼ –
Limit 26 inches.

ditto 3/8 hole top –
Cant get

ditto ½" Cant get
yet 5/8 is OK – when tried
some reduction somewhere

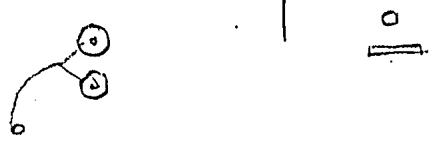
We now take off the 10" Extension + try for the overtone $2\frac{15}{16}$ air Column 28" Limit - using 5/8 hole at top -

With Brass Diaphr 8" Res 2" dia put a 5/8 hole in top but attached a tube to hole the tube Extending into Resonator

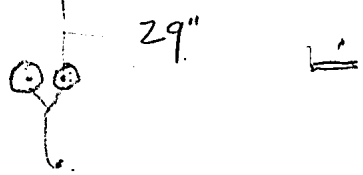


got nothing

2 2" glass Res 5/8 hole
tuned to prime line -
1 to 15 9/16 other 15 13/16 -
Limit 29 inches -



Which put tubes thus -



See no advantage in 2 tubes
in Multiplex one ear tube -

I now put 2 of glass jars in multiple one turned to prima & other the ylt for overtone,
Limit. 33 inches –
This is really a little better –
The ylt is 2 5/16 Column
The prima is 15 3/4 –

Using same glass jar in order we blew the 1st note of the gamut of reeds – Column 11 1/4 inch for prima –
Limit 39" ? Extreme

$11\frac{1}{4}$
10
X
$7\frac{11}{16}$
$6\frac{7}{8}$

$11\frac{1}{4}$
$10 \cdot \frac{11}{16}$
7
$6\frac{7}{8}$

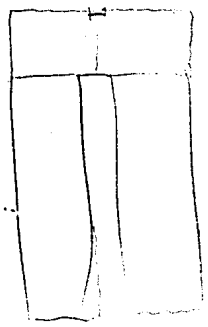
We now show the 2nd Road of giving

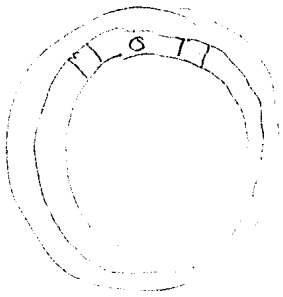
Column 10 inches

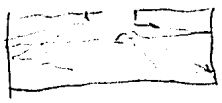
Limit $12\frac{1}{2}$

We need show the 3rd too weak to adjust.

I found these reeds require more more power to blow as you go up in scale. hence unpractical to test with Constant air pressure,







We try the 4th one which is louder prime is –
$7\frac{11}{16}$ – limit $9\frac{1}{4}$ inches

We now try the 5th – weaker
Column $6\frac{7}{8}$ limit – $4\frac{1}{4}$

Now the 6th
Can get it
too weak on prime but
hear overtone $1\frac{5}{8}$ column
Can hear it several ft
10ft or more +
I notice DE or 6th one is much louder
than the others I hear it by ear
twice as far away

Just found something ~~[illegible]~~
NE ~~[illegible]~~

FF is No 1 —
GG No 2
AB No 3 This is number
BG No 4 was blown
CD No 5
DE No 6

In blowing no. 6 - the partial is 1 5/8 and quite loud, louder than partial of old C, louder yet
When I recede from Reed I lose it but as I pass further away I

get it again, then further on
Silence. then further on
loud again & can hear
plain at End board 10ft 9"
& could pbly hear it further

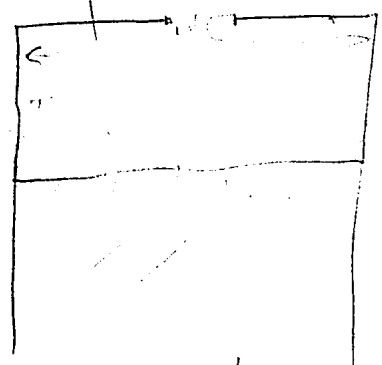
With old C tuned to
overtone acts same way
Can go 6 to 7 ft.
There are nodes of silence
to me, but not to Fred
Ott.

Evidently I have discovered by
reason of my deafness the Very
Considerable rise & fall of
Volume of Sound not perceptible
by normal Ears when resonators
in various distances from the

Source of sound are moved slightly towards & from the source, & where I find silence there is a node or antinode which works against the pendulum motion of the air going in the resonator, (ie) the waves in the resonator is not in time with the air waves. This is very strong. Whereas my best results were 30 inch from the little end turning whistle I now get 12 ft by moving resonator from position of silence to position of audibility.

I shall have to try all the experiments over again since I have found this & then duplicate them in the open air —

Note = As the very loud overtone from # 6 Reed pipe is the loudest of all yet heard even louder than C + the length of Column is 1=5/8 whereas the width of the glass jar is 2=5/16 it is evident the width of a Column can be greater than the height, or perhaps the Column was working the other way



Cross ways + it was either 2 5/16 long — or the order was in multiple one of just half of 2 5/16 or 1.5/32 — If this is true This is another discovery

It will require a peculiar "Escape" ~~[illegible]~~ of resonator to be made.

This will be valuable for extending the range of resonators for very high notes as column gets too short to be practical.

The real cause is this, probably if we put a resonator at any fixed distance from the source of sound and tune it to give the best maximum volume you must keep it there, for if you recede the sound waves will not coincide, and its volume will diminish, but you can recede

and find a point of accordance and
will regain its Volume minus the
diminution due to the distance,

It also may be due to uneven blowing, a little
harder blowing brings in an overplus
(not there when blown at each other) 10s
may have been for

~~12 best~~ Right sides = 7

I found on
trying to test with DE & glass
CC measure that our quadrant
does very uneven pressures
& therefore measurements of
Volumes is out of the question

35

7 | 18.5
4.5

32 7 | 153
2.18

14 | 15.3 (14
14
4 3

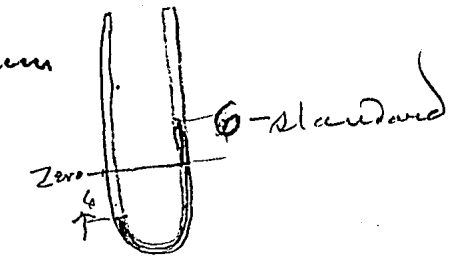
63 13 | 153 (9.
13.3

0

16
16
96
16
23.6 17 | 261 (15.3
17
9.5
8.6

Nov 4 1915

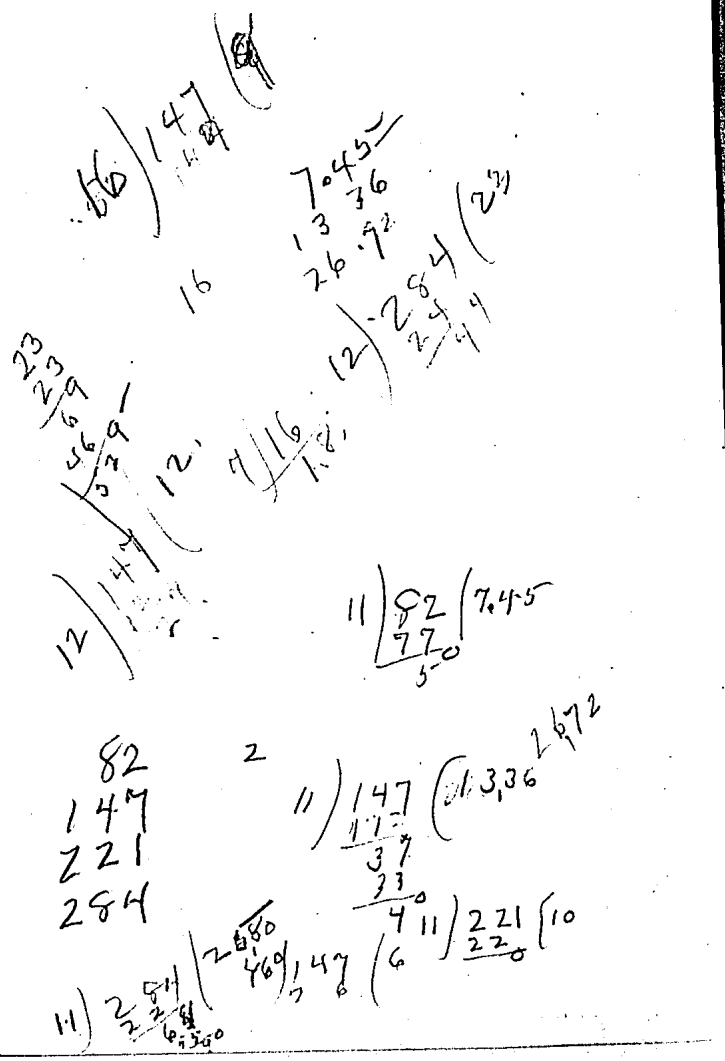
We now blow the Reeds with Compressed air from Ambrosia second dept. We use a water gauge & adjust air pressure ~~to~~ 5" on water Column



Fred Oft found a note 11/16 on 1000 cc par - blowing middle C. We have been using

We now keep the water 6" above Zero of both Columns

Tuned to Hayes, C 256 —
Column $16\frac{1}{16}$ —
49 — get nothing
84 Very strong
Edison hears Reed
11 inches
32 " obtained over ear
to make resonant Cavity
11 inches when both ears Closed
by fingers
further Edison can hear
with $16\frac{1}{16}$ Column Sure is
100 inches — but 82 is Very
plain + absolutely unmistakable
but at times dont hear
it but generally do — Over.



air supply must be regular
put in a Carboy for equalizing
Reservoir – Can hear at
100"
hear even louder at 147
We shall have to lengthen
our Index board
It looks as if the
variations at different
places along the index
is due to Echos Commandeering
or not with the Reservoir
I get it at 221
243
also 284 strong

7)16/2

7)256/36

9)256/28

11)256/236 (2.3

also get the ~~C~~ 11th partial
. The Column being 2 5/16 -
prime being 16 1/16 =

6th Nov - Moores steel
Reed - C# next middle C
Gasometer = to much
stronger than the
little grand liners
14 1/4 = Resonating
Column 1000 c c gal
Reed is 12/1000 lbs
~~C#~~ 3/16 wide - dia pipe
7/16 inside - length reed
about 3/4 ~ pipe 2 3/4
long -

I got a whole length of
index board but only
at 0 pots, I put fingers
over hole off + on to
make it glacier

Can hear at 35 meters without
hand on Ear — hear 25
feet very strong using
the Overtone 2" air Column

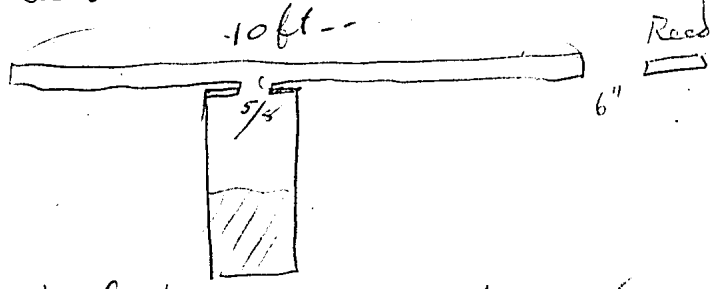
Can go into Dunwoodie
room 35 ft + hear it.

There are spots where cant hear
all over —

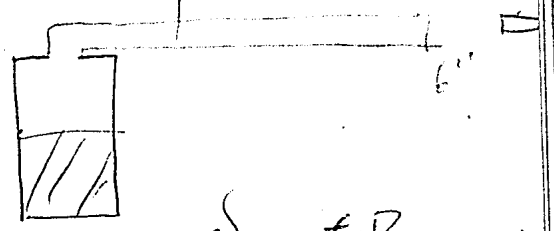
There is Echoes Resonance of
the whole room —
Its impossible to adjust Resonation
in a Room —

Nov 7 = 1918

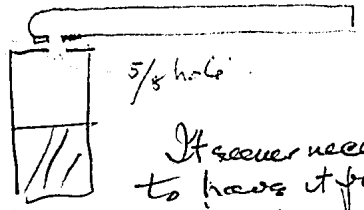
Cannot get resonate. Tube 3/4 tube connected thus



hole half way - at no place can get resonance



at no place could get Resonance



about got resonance Often went several ft away

It seemed necessary to have it free to air -

With 1000 CC jar. 2" air Column
5/8 hole

& a 3" 3/8 measure lin jar -
with 1/2" hole - The air Column
is 11/16 = There is very little
difference in Column
& in favor of the 3 & 3/8 jar
length of Column or width
has very little to do with
it. Evidently -
with 5/8 hole in the 3 3/8 jar
air Column 15/16 -

With Hollands fork in box

$3\frac{3}{8}$ lbs jar — 6" 9 thick

Opening on top	Length of Column of air in
$1\frac{1}{4}$	$2\frac{1}{4}$
1	$1\frac{3}{4}$
3/4	$1\frac{1}{4}$
5/8	1
1/2	3/4
3/8	1/2

after 5/8 to 3/8 the it weakens
It weakens about 1 inch —
test this weakening —

The 2 5/16 wooden tube —

5/8 opening	air Column for 7th co
1c	2"

The Brass Mechanical conformation 2" dia
$1\frac{1}{4}$ Hole Column 4.3/4
2" flange of tube 5.7/8

Nov 9 1918
Hollands tuning fork — Vibs Sec
prime on 1000 c c
jar — $15\frac{1}{4}$ inches
overtone is 2 inches

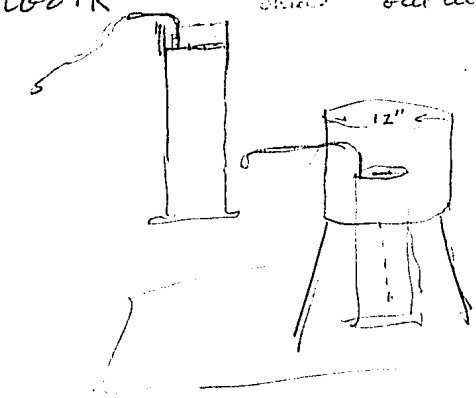
Hollands fork hereafter

The 6" jar, Can get a 7th from Hollands fork with 1/4" Column by proper hole,

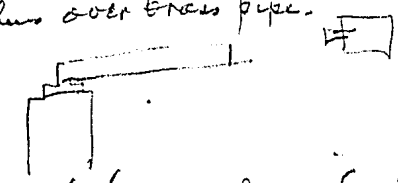
Adjust & get all the Columns with Variable holes on 2 5/16 1000 cc jar 3 3/8 jar 6" jar + Brass screw jar + the 1 1/2" glass jar —
Then Make Corrons —

1

2 = See if a shield for wind will work



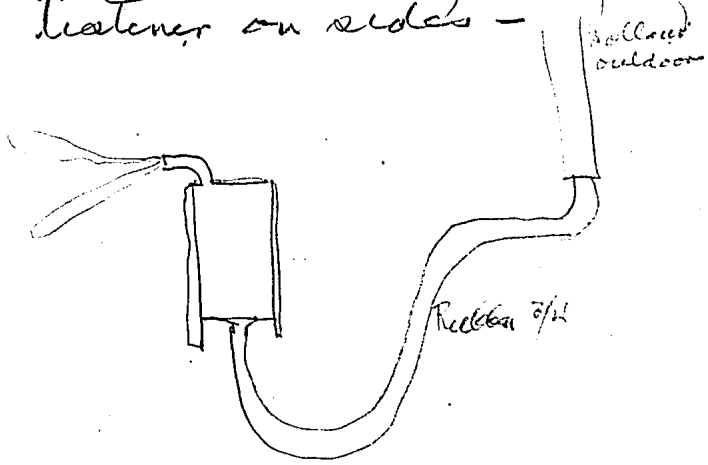
Try too much diaphrm over brass pipe.



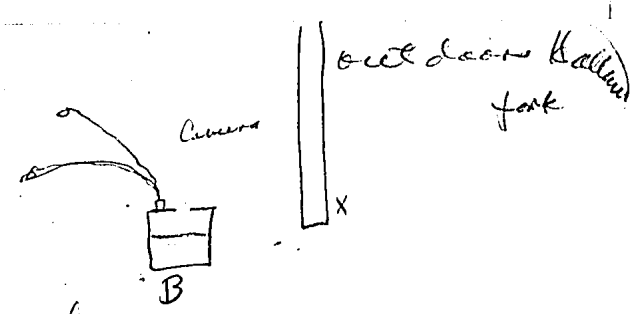
Idea Hayes make hearing seconds —

Get other forks & put Micros on —

Taper hole in 2" or more dia
3/8" down to 3/16 —
6" long —
where Camera shutter on
Brass tube used put taper
fastener on sides —



Cant find any resonant spot,
no matter what change
on this Cant find a
resonant spot, Except opening
at tap —



Right under X 1" away can't hear anything more To B 1 ft away get it 3 ft away better —

We now making a small Echo vocation box 10" wide - 66" inches long with hinged cover at one End is X + other End a sliding Echo board + Resonators can be placed anywhere along the 66 inches

Ear 7 = 49

tube 18 324

49 | 324 | 6.6 times
294
30 better

18
18
144
18
324

Hope to find out where Drums & Echoes work together without closing and Energy and in the room —

Hallard —
17/100 of amp
4 cells B 2 —
Edisons Lunt 18 ft
with brass tube
3" air Column
2 listening tubes 1 ft long
Edison by Ear 7 ft 18

Nov 18th 1918

1st test open field id
Edison Lamp
Binaural tube 2 listeners
tubes Moore
328 ft.
By ear 148 ft
Resonators 4.9 times
better - or 1.20 times
as far as twice as
far in air -
I turned the 1000 cc
jar to prime tone about
$15\frac{1}{2}$" + Moore
count 60 or more ft
I could have gone
more if Rain hadn't
stopped us - To me
the prime tone is not
1/2 as loud but to
normal ear it
carries further probably
not in tune with any
voice like the 4th +
will use prime of 4th +
2 Pair tubes

Moore says when listening with separate tube to each ear one for prime & one for 7th - That it is certainly twice as loud as listening from 1 tube with one ear

& that there is very little difference in hearing between two prime tone tubes 1 for each ear & 1 prime & 1 7th - Thinks tube to each ear 1 from prime & one from 7th is slightly louder

says the octavine needs more drill in prime & sharp like cream in 7th -

82
147
221
243
284

56— 40 24 120 | 240 (20

23 17 40 — 550—

46.6 333 20.0 999 1300 100— 1300

21 15 279.6 1998 120.0—

120 | 560 (46.6

17 7 24

283 grms NaOH

283 grms NaOH alkali

1350 27 5 0 2700 283

1.440 | 360 (1.47

133

39 17 56 100—

550 2400 3.6—

9

36 | 870.0 (24

214 36 284 144 0 7 4

870 — 3.6 | 876

870 81 89 696.0 0.47

870—

704 Copper

2.92 Copper

C 450 90 450 36 54

Cu O 65 — 12 41 6 100 65 50 65 50 65 50

65 — 12 41 6

450 65 50 65 50 65 50

3.6 50 160 234

Cu O

242 65 0 145 145 65

65 34 99 100.

430 860— 450 90 260— 81 65 40 465 5 21 450 90 3.6

65— 190 260

81 | 870 (10.75

81 | 650 (8.

157 | 870

Cu O 65— 12 41 6 100 65 50 65 50

2.92 Copper

C 450 90 450 36 54

870 81 89 696.0 0.47

870 — 3.6 | 876

3.6 50 160 234

Cu O

242 65 0 145 145 65

65 34 99 100.

430 860— 450 90 260— 81 65 40 465 5 21 450 90 3.6

65— 190 260

Notebook Series -- Notebooks by Edison
Notebook, N-18-11-26

This notebook was used by Edison during November-December 1918. The entries pertain to experiments with primary batteries, battery components, and the processing of lithium ores. The notes in the first part of the book relate to the construction and performance of twelve experimental cells made with CuO electrode plates of varying types. These experiments are continued in N-18-12-26.1. The performance tests include measurement of amps, as well as tests of fragility by dropping plates. Subsequent entries relate to experiments on processing lithium ores involving lepidolite (lithium mica) and amblygonite. Reagents and procedures are given for each process, along with notations of the presence of a lithium "line," as indicated by a spectroscope. The lithium experiments are continued in N-18-12-26.2. Also included is a list of organic solutions in which Edison tested the solubility of lithium chloride, along with notes of results from the tests described in N-18-12-21 [not selected]. The lithium experiments probably pertain to the use of LiOH in the electrolyte for batteries. There are also cursory descriptions of experimental cells numbered from 13 to 19. The notes indicate that Frederick P. Ott assisted Edison with the battery experiments, while Ludwig F. (Louis) Ott assisted with the lithium experiments. The front cover is labeled "CuO Battery Expts & Lithia." The pages are unnumbered. Approximately 120 pages have been used.

Note ↓

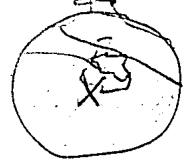
The Silicate Na ~~[illegible]~~ made by pouring a piece together with fingers, a dried half plate, put in NaOH 20%
Nos 22 was OK Dec 6th but on 16th had all disintegrated & gone to powder showing NaSilicate is no —

The Copper after reduction which was perfect all the way there was not several but perfect mechanically but was brittle & would not stand shipping without breaking in pieces —

Nov 26 1918 —

No 1 fruit jar experiment test 6 cells
5 grms NaSilicate, 100 grms Red Cu Silver Lake powder, pressed 800 lbs on gauge, Lab pieces Equals Thick, only Need lbs for in-
Coppered by melting dry Copper flour on by hand & dropping

No 1 Has broken plate

Na —  only the X

Part was coppered. Dried on hot plate only

No 1 Cell —

all reduced perfect

A part N fell out, Took out Copper found breaks very easy yet Except Center Could handle OK but was intact, gave more than Reg plates per gram made by Silver Lake —

No 2 Battery first jar is

5% Silicate Na but Coppered by Zinc dust rubbed on finger then 10% H_2SO_4 water by finger till all covered then washed & assembled

This is a whole plate & fairly well Coppered,

Its swelled bad in Cell probably due to H_2SO_4 going in pores –

Must be wet with water first & smallest amount acid possible be used so none penetrate, if Na Silicate is to be used, – possibly water should be a little alkaline

5 grams Na Silicate 100 grams CuO

500 lbs gauge pressure = 1000 lbs per inch? —

based on last photo for complete known solution,
20 drops on bottom pipe
10 inches high – 4 drops
at 18 inches –
This is merely an idea based
on the Reg 1900 formula based
CuO from Edgar Leche –
at 10 grams Eureka –

Do for Sulphide Sodium Ferric
Hydroxide Borax – break
on Hemet Lake.
Borax Cracks in Cakes

3 grams Na Silicate 100 CuO
breaks 1st drop at 10 inches
needs 5 grams –

About 10% clay - 100 CuO
pressed - dried hot plate
then in oven to Dull Red

broke 1 drop but clean
Crack center, no powder
10" drop, needs Fuller
higher broke or 15 grams
Clay -

Zinc hydroxide, too much water in it = a Red heat stood 1 10" drops make only fair.

If you use clay or brat to red you would have trouble to use acclimed Copper, same with Zinc Ox Hence this is not Commenced on the other hand

Returned plates with Silicate soda could be boiled with NaOH & Silicate Eliminated

Boric & Phos acid would not be objectionable if they dont go to process NaOH Cell —

Our $2\frac{1}{4}$" circular plate of CuO is 1/10th surface of the Reg Leclanche plate, 1 amp discharge rate is 200 Ml amp

3 amp rate 600 Ml amp

I evaporated down NaOH saturated with Zinc from Examination of new $Zn^{+}CuO$ when poured out got solid & strong - but it very soft in 20% NaOH Therefore N.G.

Dry Sulphate of Alumina.

Aluminate of Soda.

Phosphoric acid

Boric acid.

5 grams Ammonia Carbonate
Dissolved 6 cc H_2O
baked hot plate —
1 Drop - ~~[illegible]~~ no powder
12"

6 cc Ammonia
Baked . very soft powder
12" Drop
Neg

10 grams Oxide Zinc Hydrox
1 Drop 12" now powder
not promising

Took Shake Red ox - 100 grms
3 grms solid NaOH, dried on
plate, then for 1 hour kept
in Muffle at dull red
It broke on 2nd drop
no powder —
But it only 1/2 burnt
air does not circulate
+ Red oxide needs air
to be burned in a dense
plate. The Red showed
the beginning to black
whole in powder to
done very rapidly at
+ below a red heat,

Then goes black far below red

Red should have all the large pieces screened out as these burn to black very slowly compared to the fine —

So far ideal is to burn red in powder in presence of plenty air while powder is kept in motion —

The locked together with silicate soda. 5 parts to 100 of oxide dried around 300 deg take for 3 or 4 hours 4000 lbs pressure

Lake Red ox has about
10% left on 60 mesh
This is entirely too Coarse
to oxidize quickly & should
be taken out, Yet it is
practically all the
metallic copper —

A shaking screen will
take it out fine & it
can be recovered &
go thru process again

At SL they grind up old
plates seperate the lead
white Zinc mercadeon
then treat powder with
Barium Nitrate water
& use as new

Fred Ott made a desc of
Red oxide + 5 pts
Silicate Na to 100
CuO - Dried hot
plate, cant break by
drop on hard board
Exceedingly strong

It is very likely if you
put all our Red oxide
thru 80 to 100 mesh
it will oxide very rapid
& plate will give higher

Voltage as the surface exposed will be from 2 to 3 times the area

Made 3 2¼ discs
422/1000 thick

Used 100 grams Sd CuO &
5 grams Silicate Soda as
bought no water,

4000 lbs sq inch pressure

dried 1 hour hot plate 275

Fahr —

Shrinkage in thickness
003 - average
011 in Diameter

There is practically no shrinkage

Diameter of Bore are
precisely 2.288/1000

Lake black CuO produced
passed thru 200 mesh
shows quite an amount
of Red Cuprous

Notice it (16) CuO very
easily pulverized —

think we can raise
density up to near theoretical
very easily to 95%

Nov 29 1918

I find that by screening out the Coarse from Iron turnings (Cast) that it can replace Zinc powder for coating the CuO plates with Copper —

Using Red ox Iron 60 mesh & butter dish over 1/8 of sand on top of asbestos gauze & Bunsen burner fired all in 1 hours got whole black at 7 pm but on grinding found it only went in a little

Each 500 amp plate weighs about 2 lbs —

870 gms

Theoretically should get 680 amp h — ~~at 1 amp rate~~ get 438 at 3 amp or 581 at 1 amp rate

85.4% at 1 amp 70 Fahr

64.4 at 3 amp

Zinc Efficiency should give 810 amp at 1 amp rate get 593 — 73% Efficiency

NaOH, 79% Efficiency

Fred Ott now made a 1/32 steel plate & will try it over again — Temp around 700. 1/2 heavy black but dark red after grinding

Way want 2 or 3 hours —

Started 5.15. powdered as above

after 3 hours on powdering it still shows reddish — Temp is about 750° Fahr

It cannot be made CuO at this temp. in 3 hours at the size grains are — it seems there to be that size penetration where the CuO to the inner core of Cu_2O is exceedingly slow — Must have higher temp to hasten it.

Reg 500 amp plate
HL — 43 mlq per
gram of CuO plate is
amount of absorption
of water. LCtt. —

Wt before soak	125.630
" after "	131.120
	5.490

Our 2.25 Disc
100 CuO, 5 Na Acetate
Baked on hot plate
4 hours

Wt before soak	101.980	9.17% water
after "	111.280	
Water absorbed	9.300	

.091 per gram of oxide
is water absorbed
or over double Reg plate

Phos Soda goes topsiu

Aluminate of Soda evap
down on butter dish
36 hours — got very
hard, tough, 24 hours
in air still dry & hard
but it all dissolved
in water in 1/2 hour
U q for Cu

all baked dull red

3 clay + 3 clay with more water 1st drop break 1st drop - not strong enough,

5 clay thick + 5 clay with more water - only 1 drop —

5% clay not enough - want probably 7 to 10% clay

3 clay + 3 cc clay break 1st drop - 4 pieces

5 clay - 5 cc water.
break 2 pieces 1st drop
piece X stood several drops

Evidently 7 clay with 7 cc water will be OK

Silicate Soda dried in Butter dish 36 hours on hot plate
Dec 2 10 am put water over it renewed water Dec 3 10 am
at 3 o'clock Dec 3 all
the silicate had dissolved into the water ——

Hacks Book says its insoluble in K & Na salts
it looks that way. but I think 20% NaOH softens surface some & ultimately will make a mucilage
The duplicate dish with NaO has on 3rd 3 o'clock only slightly softened the surface

Conc acetates of Ca Mg Al are no good for CuO plate

Delicate of soda in
butter dish - on hot
plate for 36 hours —
taken off & water put
on, in 2 days water
had dissolved considerable
renewed water, in
1 day more the whole
had dissolved forming
a thick water glass
solution, This settles
it that NaSilicate is
too dangerous for a gen
immersion in 20% NaOH
although it appears not to

discolors in it after
4 days –

Powdered Lead glass
thru 200 mesh 6 grms
100 CuO 2 grms Caustic
Soda – Yellowish Red
heat
Stands 20 drops 1 ft
" 5 " 3 ft
on pad – also 5 drops
5 ft on wood floor
forced it down on 6th
& broke 2 pieces

Note, Make a Dese using water only + bring to yellow white & get porosity -

It coppers well with H_2SO_4 - 10% + Zinc dust Edges sharp -

Porosity - Weight before water 108,620 grms

Weight after immersion 115.900.

.067 grms water per gram of CuO -

Reg Silver Lake takes up on .047 per gram of CuO hence glass is better,

100 CuO 10 grams plaster
Paris - 12 cc water
goes to pieces in 2 hours
in 20% NaOH.

Dec 4 1918

100 CuO - 5 grams
Lead glass Horne 200 mesh
water only (Baked yellow)
Break on the drop
1 ft high - another one
break 7/10 drop -
.078 Mdg water absorbed
per gram. The one with
2 grams NaOH Conc + 6 glass
gives .067 shows that possibly very
little changed by the soda

gave 60 mah to .5

or 522 amp Hours

for Reg 870 gram

Silver Lake Plate,

70° Deg fahr about

average temp —

after soaking 2 hours

washed off & dried on

hot plate, broke on

4th Drop 1 ft high

This is satisfactory

No 3 Cell.

100 CuO — 5 grams Lead

glass 1 gram Conc. Sol

NaOH, — Baked yellow red

20 Drops 1 ft

10 Drops 3 ft (on pad —

Didnt break. Dec 4 1915

This is now on test in

a Cell & Marked No 3

gave 57. at .57 Volts

next reading 24 hours after was

down — probably

I fused (yellow red) powdered glass 25 grams with 5 grms Concentrated NaOH- & found it all fused & hard, I could stand 1/2 the soda & be fused well Enough I think

5 grams powdered lead glass, + only water, baked yellow red —

Absorption of water .091 per gram of CuO —

Weight before immersion 100.820

after 110 ood

No 2 Cell which is the same, has swelled badly & is NG — But No 1 which is also the same is not swelled in 10 days so I think a Dep. & can't say why it shouldn't swell, perhaps baked on hot plate longer However Nadhcate isn't promising — as compared to Either glass & Water or glass & same NaOH.

Disc Cupric ammonium + NaOH
8 days in NaOH 20%
all soft — NG

100 CuO 4 grms lead glaze.

500 Milg Dry soda in 5cc water
Baked Yellow red -
20 Drops at 1 ft } on pan
10 " at 3 ft }

Did not break, has a crack across

Absorption —— .073 per gram of CuO

on test Dec 5 1918

Wet before immersion	105.900
after	113.680
	7.780

Dec 5 1918

CuO 100 3 grms powdered glass
200 mesh –
250 Mil of dry soda + 5 cc water
Baked yellow heat,

20 Drops 1 ft
1 Drop 3 ft

Absorbed —— 078 per gram of CuO

on test Dec 5 6 pm 1918

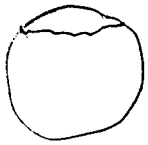
Weight before immersion 104.600
after 112 800
8.200

DEC 5 1918

100 CuO 2 grams Lead glass

160 Mlg Dry soda
5 cc water

2 Drops at 1 ft brake



Made no absorption test
with these in oven was a
mix of 5 Lead glass 1 gram
NaOH, — Dried on hot plate
it swelled up blebbly
but all fused showing
that much less soda
can be used.

Dec 6 1918

Portland Cement 10
CuO 100 — 4 days in
water — Dried —
1 Drop 1 ft broke in
5 pieces — N.G.

Fired OK made —
2 Discs of 100 CuO.
4 grms Lead of Cass Iron
200 mesh — 250 Mlg of
Dry Caustic Soda
Will put this in NO4 Cell
Soda did 5 cc water
One went 20 1st drops +
& 3 ft drops Dec 6.
put the broken disc in NaOH 20% for time test
over
5 pm

After run was over
Soaked 3 hours water —
dried — It broke at
3rd Drop, 1 ft

This is strong enough
a Salvagabony
Gives 5% amphoter

gave 58 amphours

Think this would be OK
& Satisfactory

~~Broke~~

Broke 4th time 1 ft
This would be satisfactory
gave 58 amp hours

Another 2 descs made
Same as No 4 but used
only 125 mlg Dry
Soda dissolved in 5 cc
water,

One of these went 20
drops at 1 ft & 3 drops
at 3 ft –
This will be No 5
Cell – Dec 6th
broken and put in 20% Soda for time test 5 pm
1 after run soaked 4 hours water, Dried on hot plate
Broke on 2nd Drop 1 ft –

Another pair with 62 mlg
Dry Soda 5 cc H_2O
this stood 20 drops at
1 ft + 2 drops at 3 ft
this will be No 6
Cell Dec 6
broken and put in 20% for time test 5 pm

Fred also made a thin disc made entirely of water & 200 mesh glass on iron plate — it only swelled up a little under micro its bubbly bubbles about 005 + clear all thru & perfectly fused together —

Dup of above with 250 mlg Dry Soda + 5 cc water - bright yellow. This swelled up more than ~~as much as~~ without soda but think it OK — fusion perfect, swelled 10% more But think his heat was too high considerable more than previous Experiments, It is fused clearer & much better than the above — 62 Soda which makes a strong Disc will probably be enough soda —

No 7 Cell-

100 CuO- thru 60 mesh
250 Mlg dry soda, 4 grams ground glass
thru 200 mesh, 5 cc water
10 drops 1 ft. [Note think was a flaw]
Baked higher than previous ones.
seemed at full yellow-

Made 1 drop at 1 ft- broke

This is OK but ought to drop
2 or 3 times to be perfectly
satisfactory -
Probably something wrong
in mixing -

Gave 61.95 amp hours to .5

Cell No 8.

100 CuO thru 100 mesh.

4 grams lead glass thru 200 mesh

250 mlg dry Soda 5 cc water

Baked full yellow

20 drops 1 ft 9 drops 3 ft

grid 63.45 avg hours. to .5

Broke 1st drop 1 ft no fuse

Think this will be

a duplicate

		Total amp H
	660	
	650	
	650	
	640	
	640	
	630	
	630	
	610	
	600	
10 days 24 hrs	600	52.350
	580	
	580	
	580	
	560	
	540	
	530	
	500	64.150
	258	

Cell No 9

100 CuO thru 180 mesh

4 powdered lead glass thru 200

250 mlg dry soda 5 cc water

Baked full yellow

20 drops 1 ft 7 drops 3 ft

This disc at 200 milamp discharge rate averaging 70 deg Fahr -

gave 64.150 amp hours

Equivalent of 558.1 amp Hours for large plate.

Broke at 2nd drop 1 ft but it had a flaw

This is OK + calculation

Thinking that last 2 bakes
Cells 5 + 6 & 7 8 + 9
were baked too high &
duplicated them & baked
so I could see thru the prep
hole that all were red
at dull red the edges were
black, but when turned up
edges were seen to be
bright & not black & ~~[illegible]~~
slapped heat

~~[illegible]~~ Cells

~~[illegible]~~

The glass recorder alone
with 250 mlg dry soda
4 grams glucose moistened
with water made into
dough & baked with
10 11 & 12. swelled very little
debut has glassy surface
but was well fused
together

OVER

Discs of this Cake described on preceding page.

Only gives 1 Drop at 1 ft & are entirely too weak.

The Experiment discs must Bake a bright Yellow to give proper strength & the disc of glass must have a shining or glassy surface —

Above were Reg SL Cu not screened which has very little strength compared to 100 mesh

Repeat (not screened) 100 CuO
Made one with 3 Lead glass
64 mlq Soda 5 cc aq
Baked yellow Red -
Broke 5th drop 1 ft
probably not high Enough
in heat or not Enough
soda - will Rebake
to higher temp, the
other one not broken
After baking full
yellow, broke on
5th 1 ft drop -
We must use CuO thru
100 mesh to get 3 Lead
glass to work -

Req 5 L CuO not screened
100 CuO | 4 grams BEST
Bottle glass, 64 Mulgdada
5 cc dq — same lamp
as on previous page
yellowish Red —
5 Drops 1 ft
probably not high
enough temperature
or not enough soda
will rebake the other
one at higher temp
After baking to full yellow
gave 20 drops 1 ft
2 " 3 ft
looks like 4 glass 125 Soda
+ 100 mesh CuO + yellow Red

Put remaining one in Cell & Mark it No 12

Note, it was cooled slowly

I had two of the 3 which broke 3rd drop - put back in Muffle & heated full yellow it made 20 1 ft drops + 7 3 ft drops & one 3 ft drop on floor

This is OK for bottle glass the heat must be higher than lead glass,

Make 3 Dies of 4 bottle glass 100 CuO thru 100 mesh 125 mlg Soda .5 cc of Yellow Red

+ 3 Dies of full yellow CuO thru 100 mesh - 125 mlg Soda 100 CuO, 4 bottle glass - 200 mesh

1st Lot - just yellow red only little red,

All broke 1st 1 ft drop second pieces Easily breaks with hand, bad mixing or something wrong as we have had with lead glass at Even a lower heat 20 drops 1 ft

see previous page,

Duplicated at ~~[illegible]~~ more yellow red & cooled slowly but broke 3rd drop 1 ft

No 12 Cell in bottle glass 4 -
with 125 mg Soda -
Heat was yellow red broke 3rd 1 ft
drop - put it back in furnace
& heat to full yellow
made 20 1 ft 7 3 ft -
& slowly cooled down
Want get capacity & voltage
This time diminished in
Dia .004 only

Broke 1st Drop 1 ft

But its OK

~~Made~~ The full yellow
ones well test on 11th
in morning

These came out OK 20 drops 1 ft
2 at 3 ft -

We let these cool down in
furnace. Think all cooling
should be slow otherwise
particles will be
unannealed & brittle
shattering on dropping &
perhaps on cooling too quick

Also they should be given
a low heat to cause
water to slowly evaporate
out & not make bubbles &
disrupt.

Should say 200 mg
Dry soda to 4 beer glass
200 mesh 5 cc H_2O should
be used to give margin
for variation of thermometers

Li_3PO_4

5.56287 phos Li corresponds to 1 gram Li in ore

perhaps 250 mlq soda could be safe ~

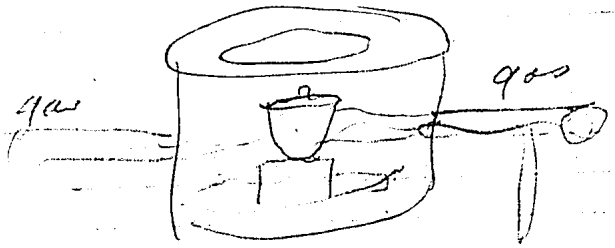
Put up a Cell — No 10

2 of this

Make some 100 mcd CuO
4 lead oxide 125 mg Boric
5cc water. When grinding or
rolling mixture of add 1 gram
of fine graphite & mix well —
Burn then bake yellow heat
+ Copper + put in CoCC
+ crack one —

Cell No 11

Lepidolite Dec 11 1915



Small Crucible holding furnace —
Use 1" x 2 deep graphite Crucible, 10 grms Lep 5 grms salt, 10 cc water
Evap off water by heat + when all off put in furnace heat to yellow heat, rod would show down easy the viscous filled mass (not liquid) took out / took cover off Lets make put it quickly back

Lepidolite wasn't moved short long 1/2 1/2

any furnace that melts it must have baffles at chimney to divert the volatilized stuff presumably chlorides —

After Crucible in boiling water for 1 hour Lep dont soften — Broke Crucible and got out mass & put in water — wont dissolve —

I exhausted it after powdered up, boiling water
hardly attacked by phosphoric after precipitating by excess NaOH

The put residue in 50% H_2SO_4 & heat to decompose remove H_2SO_4 —
This apparently does the trick
after cooling added water & filtered, added excess NaOH, some precip came down filtered it off — added NaPhos very large precip, small number fully ppt had change to another & larger

~~[illegible]~~

large breaking - started filtering found had not added enough phosphate, finally added 1/2 bottle full — [Too weak of quench]

Am now filtering - if this is phosphate this quench is going to be easy

10 Lep
10 plaster Paris —
Yellow white in furnace — not legured but soft viscous —

10 Lepodolite
10 Salt
20 Chalk -

Strong Lithia line in water — after boiling hard — Reboiled & still get Li line -

10 Lepodolite
10 Salt,

Strong Lithia line in water filtered there — no Lithia line on subtracting screen

This seems better than when lime is added -

After boiling more get Li line — but very faint & only at times

Note

31 Mlg/dl Oft in 250 cc water Seems the limit on direct Vision Spectroscope ~~see~~ ~~[illegible]~~ ~~faint~~ Cant say that I can see it, probably [illegible] good

64 Mlg is steady line faint Comparatively — $\frac{1}{4000}$ OK —

Very bright yellow white

#15 Fusion is
10 dependolate
30 Chalk
2 Salt,
} [illegible] fused Viscous

#14 is
10 Lepidolate
10 gypsum
3 Salt.
} fused

#10
is 10 dependolate
10 salt
20 Chalk.
} fused

#13 is
10 dep
10 Salt —
} were fused producing melted +

No 10 — Must fuse a longer time — Duplicate this fusing after reaching yellow white for 1 Hour —

Another Sample 2 hours

Final test of #10 diluted to 250cc much stronger than 1/2 gram & nearly if not as strong as Standard gram of Lithia, on 3 gr 6 oz

~~#10 — 3rd Exhaustion 12 hours on hot plate all night was dry at 10 am Sunday morning Got 30cc very bright Lithia Line strong showing that time must be allowed to get in the cleavage planes of the crystals even windows only scratches up not dissolved~~

No 10 — 3rd Exhaustion only very faint Li line, 12 hours on hot plate & dry in morning 10 am —

Dep is 100 mesh instead of 30 which this is & 24 hours boiling & this followed off & a 2nd water leach couple hours boil think will get it all —

Later taking some of the powder from the 4th Exhaustion & grinding on asbestos the Lithia line is strong showing that the ore has not been attacked enough to free the Li OH

#10 Continued

My impression is that No 10 formula with finer ore + longer fusion, + regrinding fusion very fine as we did #10 after it came out of crucible that we will get most of the Li out

The question is - is time necessary

#13. The residue after 3rd Extraction has some Lithia showing Lep not powdered fine enough + not heated long enough to penetrate fully there some of the Lepidolite,

250 CC - Dont show more than 500 mlg - not near as good as No 10 -

Evidently time of 10 minutes

15 - 2nd Extraction

Very faint Li Line with liquid 50 cc — powder gives rather strong line.

Say equal to 250 mlg Lith in 256 — again shows lepidolite not fine enough & not heated long enough —

250 cc less & think than standard test of 500 mlg around this —

Note Standard 1 gm Lithia 250 cc
adding phos soda no precip on
boiling large precip —
delta 500 cc Lithia sol —
250 cc dont show precip
probably because the amount
that would precip is soluble
in 250 CC — ~~[illegible]~~
~~[illegible]~~,

Phenomenon →

#14

It is not so strong
as 500 mlg 256 standard
Lithia Slice in Ranchu —
Must Crush are finer
& free longer — residue faint
to nothing —

So far #10 Best, in fact
very good, c-

Note in test tube with Na phosphate
No 10 no precip
13. a little
15 Considerable
14 bulky precip

Evidently none of the processes up to now gives good yields —

Have written up several more.

Note, I took a little lepidolite powdered it fine + put it on platina lid + brought it up to yellow on tripod. 15 minutes then under micro it showed that 50% of the mica had whitened + puffed then heated 15 min more + additional ones puffed, after 35 to 50 minutes 99% had puffed but a few showed central specks clear + not puffed. This shows that if kept for couple hours at a yellow all will puff. The leaves separate. I also notice that when I put the red hot Platina suddenly in cold water it broke a large part up, then I ground this wet up Martar + went almost to a jelly. Undoubtedly this

treatment is good for any
kind of a process, Especially
if acids are to be used or
even fusions & this
preliminary treatment is
not expensive — of the ore &
has about 3/4 lead mica & 1/4
clear quartz like material
beautifully drawn powder.

Lepidolite, ground 30 mesh
ignited yellow till caked together
while hot - taken out & crushed
finer. Then ignited again
thrown in hot water, & ground
again —

200 cc H_2O + 10 grams dep
with 10 or 15 cc Hydrochloric
gives strong line, better than
500 ~~milligrams~~ grams of LiOH +
not quite so much as
1 gram LiOH, acidified by HCl —
250 water —

2nd extraction by HCl —
250 cc water, same no graphite
that 62 Wiley standard LiOH.

Above is wrong as to double
ignition. There was only 1
ignition & final grinding
otherwise OK

I now start on the double
ignition

Experiment X

Lepidolite about 50 grams thru 30 mesh ignited alone till sticks together Crucible thrown in water till cooled — some stuff went into large jar water perhaps some Li Oh dissolved in water which I collected Then the water filtered to get floating stuff & balance removed from Crucible 95% stayed in Crucible — The whole reground very quite fine powdery 150 @ 180 mesh — The Reignited thrown in water same way Collected + reground —

This is what I am using

X dep

10 Grams above in 100 cc water Only —

in 2 hours nothing no line put in about 5 grams NaCl

This brings out some lithia not strong yet —

10 Lep X

5 cc Conc Sulphuric —
50 cc water 17th 1130 am

Residue much less in bulk than HCl Extraction
no mica visible, Think the now mica transparent is all attacked as see no pieces 1/2 white + 1/2 clear,
think about 750 mlg in 10 Lep.
it lasts longer than HCl —

Easy to filter clear solution
weight of dried residue 2.920.
Now Evaporating to dryness will drive off acid after drying + weighing + then reweigh

10 Lep X —

50 cc H_2O - 5 cc HCl — 17th 10 30 am
hot plate,

Residue much more than sulphuric Extraction,
no mica is visible, even opal micaceous
Notice a few pieces of clear stuff 1/4 white other part clear but no 1/10 the number there was before we double ignited + double ground

Think Li have checks more bright than with Sulphuric but dont think it lasts as long + Dont think there is more than 750 Mlg Li in the 10 Lep HCl extraction.

Note. Its almost impossible to filter the solution clear after 3 or 4 times its still milky Weight of dried residue is 4.540 grams some lost in filtering.
Now Evaporating to dryness will weigh the HCl to be driven off

~~Reweighed the [illegible] then driven off [illegible]~~
Reweighed after washing + deleting the 250 cc [illegible] grams

OOE

~~Lithia line about equal to 125 mg standard solution 150 cc ... showed equal to 500 @ 750 cc standard — white ... the alpha.~~

The original 001 250 cc Evap dacon showed 1.484 gm this is amount dissolved by the 5 cc HCl —

Li line about same as 500 mg in 250 cc standard — when dry residue dissolved — 250 cc water —

The 4.540 all night in more HCl — evap to dry HCl driven off — then 50 cc water Cant get the Li line ~~at first after~~ 1/2 hour get it strong — it seems to take time to get out of cleavage or porous stuff —

Hence Li + 1.484 Residue — total 6 gm 4 lost in alkali + residue on filter paper see further along

I note that in the first trial of HCl on 10 drop ~~and~~ not evaporated the 250 cc Evap to dry that just before dry it was a jelly — probably silica

10 Lep. 80 000 in a ton Sulphuric would dissolve 7 out of 10 grammes

or 1244 lbs this is entirely too much — 1333 lbs lime acid used —

Must now try the minimum H_2SO_4 that will remove the most of the Lithia —

With HCl 5 cc. 911 lbs of ore would be dissolved + 911 lbs HCl would be required — Must also determine minimum HCl that will do the trick

10 Lep X double ignition
HCl 5cc 250cc water
Continued –

Think 5cc to 10 grms too much – Think 3 cc will do just as well –

The residue will be when 5 cc HCl to 10 Lep used 300 lbs –
in this is the alkalies + other stuff –

Sulphuric Acid & 10 Lep X
5 cc H_2SO_4 Conc is out of the question it dissolves a considerable amount of alumina + frees the silica but only little of any Silica dis in the 250 cc water like the 10 grms was treated with its all alumina & phosphates not by ~~so~~ far HCl but by far

Note –

Just heated piece lepidolite size of first yellow & phosphorus with Conc water – it turned white & crystals friable ~~but~~ crushed with hand into coarse powder, this will make it easy to grind, but dont think mica broke ~~are separated~~ This will be done after 2 month grinding & ignition, possibly a longer grinding & another ignition –

Cold water containing X
Lep 1 gram passing CO_2
for long time don't appear
to dissolve any Li —

I will now try SO_2 in water
which is stronger acid —

In morning found it dried on hot plate its been on all day Tuesday night 6 pm added 5 cc Conc HCl & filled up to 250 cc to make up some ½" evaporation —

Lyons Calculation shows that to get all alkalies out alone require 8 to 10 cc HCl 37% + 3 cc was totally insufficient

One 10 gm Lep exhausted with fresh acid each time, for many hours 2nd showed strong Li Line after several hours. The 3rd exhaustion had its residue ground extremely fine in agate mortar & put in 10 cc acid after several hours Li Line very weak & difficult to get now on for 4th Ex 5 cc HCl — all night will test for Lime with less water

No 1 —

Pink Lep - Ignite 100 mesh then ignited, quenched water 10 grams 250 cc water 3 cc Conc HCl —

Left warm on hot plate all night but not in actual contact covered over with watch glass —

This Lep is very much richer than the White Lep been using Examined in glass before HCl — Mass all white +, whole looks good for leaching on gas 2 hours, off at 6 pm 18th until morning —
Line about like 500 Mg standard But its pink + much richer in Li

No 2.

Pink Lep- fine + then ignited
Repowdered, - in SO_2 15 hours
Cold, Sol still very acid even
after boiling 2 hours -
(not strong boil) - its strong
in Li line with 250 cc

Residue in about 15 cc water
+ 5 @ 10 cc HCl acting on it for
5 min gives strong Li line -

No 3 Cold 250 cc H_2O in flask

3 cc Conc HCl — see addition of HCl at 6 pm —

10 grm Lep ignited in muffle

Quenched — Reground & ignited Cold leach

in small Crucible; dep wont high grade only slight pink —

12 Noon 19th. Its redish

probably from iron,

Under Micro, scarcely any mica — what there is is opal — considerable quantity of clear quartz like particles, but all are finer than usual — There is abscent the white porous non micaceous pieces seen before —

at 6 pm put in 3 more cc HCl

Total 6 cc HCl —

Dec 23 1 cc deducted to 15 cc line

OK but V Very faint

It was at the end slightly acid

Think I used about 10 grams Caustic Lime - Sol Hot,

filters well, quickly, but requires lots washing on filter to get rid of Lithia Lime, 6 times so far & lime still there but weak now

After all out of lime & filtrate gave no lime, I put some of the Mud on wire pad & got brilliant Lithia line. Can it be some Li is combined stuff with ore

Now break filter & wash mud thru into 2 Casseroles to heat the water to boil & refilter to see if Can't get Li out,

I filtered the big sol which had lime thrown down by Oxalic filters clean & rapid, There is not much lime in it —

see new book

No 4 Leach solutions 75 C on butter dish -

Dup of #3 same stuff

3 cc HCl — see addition 3 cc at 6 pm -

Thru to be warm —

12 Noon 19

at 6 pm put in 3 cc more HCl Total 6 cc HCl 9 cc HCl

Dec 23. 9 45 am 1 cc diluted to 15 cc get lime weak but steady & a little better than No 5 at 5 cc dilution.

Off. 2.45 pm Dec 27 - I used say 20 cc of the liquid prepared

Now whole ore & all treated with WV & Caustic Lime & filtered -

at 11 am - 26th found only dull Lithia line showing not much more has come out but should say the Oxad must be very fine & well ignited & 10 days given it warm -
(note) sure that a large amount Li want locked up in the particles yet, but they look light & act light and are snow white,

The weight of Residue is 7.904 - I lost probably 100 to 250 Milg on paper

Treated residue till Dec 30th with H_2SO_4 - then filtered, washed residue water, filtered, then put this with 1st bag of filtrate & treated all with lime filtered & treated with oxalic when free of Ca. filtered this is a conclusion for Group to Group = note oxalic made after lime was filtered off a precip but Sol acid, also Ox of Na both acid to the H_2SO_4 I used must have something else

Had oxalic in case Back which gave surprise precip

No 5

Oxadumane, yellow in Muffle then in Aqua-Ground, ignited in small Crucible filtered & decanted, dried & reground - not very fine - 5 cc HCl. 250 cc aq

On warm - 19th 4 pm -

at 6 pm can only get a trace of Lithia line,

All night 11 30 am 20th only get a Li line like a little better than 62 standard

4.30 pm 21 Dec I notice that the Li line is very bright - time to see element as well as heat possibly weeks would extract it all -

at 9.30 am - Dec 23 - Took 1 cc diluted it to 5 cc line full & dull.

Dec 24 5 pm Removed solution by filtering & put back residue for further leaching with 5 cc Conc HCl - on plate at

#6

Dup of 5 —

Cold

250 cc ag

All night — 1130 am — Cant get the Li Dine —

4.30 pm 21 Dec Lithia line is only about 250 mg standard — not anywhere near as bright as Dup hot,

Dec 23 — 11 am — 1 cc detubed with 5 cc Cant see Lithia line

11 am 26th Dec
Only shows rather a dark line
rather quickly fading —
looks as if most Li was out of
ore,

The 10cc HCl brot out considerable
more Li, & the residue is now
small, with very little Li when
powder is ignited —

No 7

Ambiguite, Muffle to yellow
Quenched, ground, ignited in
small Crucible, yellow,
Quenched, Reground
10 grms 10 HCl Conc 250 ccs
to go on hot plate on
butter dish —

19th 4 20 pm

In ½ hour got Excessively strong Lithium
Line

Dec 23 10 am — 1 cc diluted to
50 cc get Line faint butter
butter Uses spectrum 5.

at 3 pm + no Li coming out in water
I put in 200 cc water & 10 cc Conc
HCl — to go on Hot — Dec 23 3 pm

8 Dup of 7
but heated Cold
19- 4 20 pm
250 cc aq

Dec 23, 11 am 1 cc diluted to
50 cc line & think is even
stronger than Hot Dup
No 7 - apparently showing
no advantage of heating
+ is probably not a porous
leach from fine holes but a
Dissolve - or an extremely porous
condition due to ignition.

time is an element as the spongy particles must have extremely fine pores + as acid is very dilute it will take a long time to come + go — should say in practice <u>One week</u>.

The only question seems to be ignition furnace + time of leaching — for Lepidolite,

I ignited lepidolite chunk weighing about a lb in muffle to fuse yellow — then suddenly threw in water, it turned white + was friable but only to pass about 1/16 — by grinding these very fine in agate mortar it is seen that all the iron component + would not be attacked by acid except outside surfaces —

It evidently wants a 2nd ignition in very fine powder + quenching + even this will not ~~ex~~ solution all perhaps 2/3 will solution —

Possibly a 3rd ignition might ~~satisfa~~ spongy the whole. But if all can be ground fine enough to float off think 2nd ignition will do it, + even then it should be leached + the leached stuff regrounded finer + relleached

According to Lotts figures 2000 lbs 4% Li metal in a Lepidolite ore + 10% K metal will require 1640 lbs of 37% HCl acid to turn the 2 alkalis into chlorides

10 gram sample needs 820 cc aprox of HCl - to Exhaust it, supposing ore had 4% Li metal + 10% K metal -

Dec 20 - 1918

Pink - high grade Lepidolite double ignition -

250 cc Aq + 5 cc HCl - strong
2nd Exhaustion 250 cc fresh water 5 cc HCl - This was strong Li line.
3rd Exhaustion: the residue was reground very fine in agate mortar + 5 cc fresh HCl + 250 cc fresh water used - This also gave a good Li line - The put in to 250 cc fresh Aq + 5 cc HCl all night on hot plate, - Lithia line a little weaker than 62 Milg standard, probably 50 Milg left

By proper ignitions + flow like grinding - could get nearly all out with 10 HCl - leaving very little in Residue

Weight of residue including a little I got off the filter paper which was light fluffy stuff —

Weight of residue in Casserole 7.100 —

Weight from filter paper — 2.308

Total 9.408

Some Lugl chloride must have been taken up — as we only have taken out .592 mlg.

It doesn't seem possible that the extraction was all dict

It made an error, I put the Casserole residue + the filter paper residue together + he made it.

Real weight of Total Residue

7.662

Extracted 2.338

I notice when I heated residue after weighing to weed it into gas come off - probably not dry

I ignited the entire residue from the residue weight of 7.662 grams and in minutes crucible weighing 2.250 it broke in 500 HCl for 1½ hours filtered & filtered — put in 500 HCl for 1½ hours filtered & filtered — 2.250 — 2.250 — 2.250

No. 9 –

Lepidolite, fair grade not pink
ignited in muffle yellow, quenched, powdered not.
Extra fine. Then ignited in small crucible till
it tends to stick on top, lid fritted white, quenched
ground fine –

10 grammes – 8 cc conc HCl commercial
put in flask, on hot plate on butter dish
200 CC water, poured in HCl, then ore
then water, On 2 pm. 20 Dec Hot

~~at Dec 23 10 am Test [illegible]~~
~~[illegible] Alle better~~
~~Then Specimen No 5~~

Leo

No 10 Dup of 9 but cold
Leach — 200cc aqr & HCl -

Note =

No 11

Is the same Lep at 9+10 but in this case the ignition in the small crucible was higher so it had passed viscous thick state & got solid so iron rod wouldn't move it Repowdered fine —

200 cc aq 8 HCl Conc 10 Lepidolite to go in a flask on hot plate on butter dish —

20th Dec 2.20 pm —
put ore in conc HCl + aq aqua regia —
~~Dec~~ -

The ore on watch glass seem to be more disintegrated than 9+10 fusion — but there is a large amount of transparent there yet, entirely too much to get good extraction;

Dec 21 4.30 pm I tipped flask & lost about 10 cc aqua but none of the ore —

No 12 Dup of 11 but
Cold beach,

Dec 20 2 30 pm

fused good, puffed up bad

13. Chunk Lamited & powdered + the powder fused

200 CC water

20 grms of following Mixture

25 grms pacor Lepid olite (white)
25 " Carb Soda —

fused till semi liquid ..
ground up — powdered fine

Now leaching in water only

Dec 24 9 30 am on heater plate
Butter dish —

off - Dec 28 - washed (1e) filtered
Used big beaker full as of
Li_2CO_3 it wanted acc. demand

then recalculated the reaction
with HCl - filtered

14 No 14 —

Dup of 13 Except,

The Mix is 25 Lep (white)
& 12 Carbonate Soda —

of this 20 grams of mixture is
used, 200 cc Water

Dec 24 — 9 30 am on plate with
butter dish —

Strong Li line so salt does not extract all — perhaps I should have not used acid but just water & give it time to percolate out of pores —

This Experiment should be tried again —

I notice the mud dont give as line but if wet with Barl gives good line.
Li appears locked up with something Leaving by Barl —

I added water after exhausting all I could with alcohol & dissolved the salt then added excess alcohol to precip salt after filtering dont get much salt
think it dissolves somewhat in alcohol

Lost

15

Lep Chunk ignited in Muffle & quenched powdered — then fused Lep 1700 grs

fused Mix 25 grms white Lepidolite
25 " Salt.

fuses ok, hard to get out of Crucible

Of this took 20 grms finely powdered 200 CC water only
Equals 10 grms Lep
Wgc 24 on butler dish
hot plate 9.45 am —

filtrate brot to dry
mitchsalt Crystals and ground up & treated with alcohol — different to extract all the LiCl from it as some must be in the Crystals of salt ground it stice Clamos out of 3rd Extractions with alcohol after grinding —
treated Residue with acid and filtrate from this gives

#16 — Lump Lep white, ignited in muffle bright yellow quenched, Powdered,

25 g. Lep
50 g Sulphate Soda -
fused together — Then powdered fine

20 grms of this used for Leach

200 cc water only

Dec 24 9.45 am in water only On Buchner funnel on hot plate —

✓ Trichlorohydrin fair
✓ Orthocresol good
✓ Monobromo Naphthalin faint
✓ Monochlorophenol fair
✓ Methylene Chloride good
~~Alcohol Butyrate Strong line in flame~~
✓ Benzene Anthracic faint (doubtful)
✓ Guaicol Bright line in flame
✓ Paramidophenolat faint
✓ Amyloxyd Butyric good when flaming
✓ Butylic Ether. Brilliant line
This is fine solvent
✓ Methylal faint
✓ Anisol Aldehyde faint
✓ Metaldehyde good line
✓ Methyl Ethyl Ketone good line
✓ Monochloro ortho phenol faint
✓ Isobutylbromide "
✓ Methylphenylamine "
✓ Trichresol CP. fair
✓ Eosigsaure Anhydride ? Brilliant

Many of these should be followed & verified as LiCl got on side of test tube —

~~Organic Solvents~~

The following organic solutions are discolors of LiCl

✓ Amyl Acetate good 0.18 in 100 W
✓ Amyl Alcohol Very good — S Sol W
✓ Acetone Very good "
✓ Pyridine Very good ?
✓ Benzaldehyde
✓ Nitro Toluol — good — doubtfull it was in H_2O_2 VV Little Sol W
✓ Monoaethyl ortho Toluidin fair " "
✓ Dichlorhydrin Pretty good — 1.1 in 100
✓ Paraphenetidin. faint after flaming cool
S.W. Meta Toluidin good " "
✓ Methylbenz Aniline Very good
✓ Perchlorethylen faint after burning off
✓ Creosote oil " " "
✓ Orthophenetidin faint "
✓ Eucolaptol faint
✓ Picoline Very good
✓ Butylic Alcohol Very good
✓ Methylene Chloride good — ? ?
✓ Benzol Chloride faint
✓ Phenylhydrazin good
✓ Dichlorobenzol good

These fine 180 mesh plates shrunk considerable —

Diameters of 4 discs	Thick
2.214	.446
2.230	.448
2.229	.448
2.238	.451

The Die is 2.287 —

Shrunk 58/1000. in Diameter

Battery 13

100 CuO & 200 mesh lead glass
250 mg q - Soda glass — Baked yellow
CuO then 180 mesh
Run at 600 ma per disc
rate ordinary limit
Ordinary temperature

Dec 26 11 ~~[illegible]~~ Am —

14 Battery

~~Dup of 13~~ —

In Dec 26, 11 am

Battery 15

Dup of 13 Except
run at 200 Milliamp
rate in Ice Chest
on Dec 26. 11 am

Battery 16

Dup of 13
Except discharg at
600 Milamp in
ice chest
in Dec 26 11 am

17-+18

Cut by red heat
on $CuSO_4$ 4 Pb glass
1 gram Dry Soda

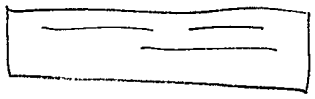
2 Discs

Did not shrink
any in muffle —

19 - precipitated
CuO - heated just
dull red
4 grms lead glass
1 " Dry Soda

Shrunk much
from 2.25
to 2.10 -

Cracked
1 time



Notebook Series -- Notebooks by Edison
Notebook, N-18-12-26.2

This notebook is a continuation of N-18-11-26. It was used by Edison during the period December 1918-February 1919 for notes on processing lithium. Among the ores used for experimentation are lepidolite (lithium mica), amblygonite, and spodumene. The entries describe different fusing, filtering, and leaching steps, along with the reagents employed, and note the presence of a lithium "line" as indicated by a spectroscope. Also included is a list of organic solutions in which Edison tested the solubility of lithium chloride, along with notes of results from the tests described in N-18-12-21 [not selected]. The notes indicate that Ludwig F. (Louis) Ott assisted in some of these experiments and performed assays on some of the final residues. The front cover is labeled "Lithia Dec 26 1918." The pages are unnumbered. Approximately 100 pages have been used.

I notice on Dec 26 – the Cold Dup gives a very bright Li line,

on 19th 4.20 pm

No 7 Ambligonite –

Shows that, when Amblig is quenched, reground, ignited again & reground fine – that in 4 days on hot plate on a Butler dish & followed that most of Lithia comes out. If now – the residue w/ Ephemeral + fresh water put in with 10 cc HCl more & kept for 3 days the residue is small & practically all the Lithia is out – testing dry residue in flame gives poor line

Think that 7 cc HCl 1st Ephemeral & 4 on 2nd will be commercial if finely ground

C13

Chunk of Pink Lepodolite ignited quenched - powdered put in Casserole Dec 19th 9 am - 10 grms with 3 cc Conc HCl at night put in 5 cc HCl more. Total 8 cc HCl.

Taking off hot plate 27th Dec 930 am it was nearly dry & hard Caked together, added about 100 cc water & broke up Caking but still sandy after boiling 1/2 hour -

It was only faintly acid so I added a little HCl - filtered

Lime process –

After acting on ore for several days boil the solution with ore & all in & then add proper amount of W Va lime 3/16 size & stir & keep boiling for a little while – Then filter hot, filters rapid & good, then wash several times with minimum of hot water till Lithia line disappears in direct vision spectroscope, Boil the clear solution & then add Oxalic acid till its on the verge of being acid this throws down all the Lime, filter hot, filters rapid –
The liquid will have only the Chlorides,

13 -

Ambliqonite - Chunk ignited & quenched this is dried and ground up to about 100 mesh & ignited in a mond box to a temp where its semi melted & sticks together quench in cold water, Then powder up roughly & assay samples are ground to 200 mesh -

This is 10 grams of Ambliqonite 10cc 37% HCl, diluted with 40cc water.

On butter dish over hot plate Dec 27 5.20 pm

The temp of the solution well over 75° Cent. - probably less as butter dish is old thick one

Final Test of Solubility of Lithium Chloride in Organic Solvents
Solutions filtered

Amyl Acetate	good
Amyl Alcohol	good
Acetone	good
Pyridin	good
Benzaldehyde	weak
Dichlorohydrin	fair
Piccolin	good
Ortho Monochlorophenol	fair
Methylene chloride	good
Butylic Alcohol	V good
Guaicol	Try again

Amyloxide butyric	good
Aether Butyric	V good
Metaldehyde.	good
Orthomonochloraphenol.	faint
Trioxsol ?	fair
Ergosaure Anhyd ?	good
Phenylhydozine —	good

14 –

10 grms Ambligonite treated as to equilibrium like # 13.

40 cc Alcohol
10 cc Conc HCl –

Dec 28 on warm on wood piece – 3 20 pm –

Carb Ammonia dont precip Li_2CO_3 from Chloride di but Carb Soda does —

~~Remarks —~~

~~The solution from No 4 deposited, filtered on (see book 1) in Several days — poured all into a Crystallizer as~~

Continued from old book

Dep. No 4 of old book

After washing the Lime sludge well there was still a faint Lithia Lime + sludge — itself gave brilliant lines — after exhausting all night in Cassenales filtered off + treated with Oxalic to throw down lime — boiled down to few CC + added Carb Ammonia — Thus precipitated Li Carbonic + filtered it off to about 1/5th (was CC weight) of the first precipitation with Carb Soda —

The solution being filtered off from Li_2CO_3 there was

still a brilliant line in wash water & good line even when diluted to 250 cc

I then evaporated it down having added HCl & nitric ac to oxidize the ammonia & get a residue — Evapt'd to dryness of course I then treated dry residue with alcohol & this gave a brilliant line while the residum that didn't dissolve in alcohol was acidulated with HCl & put in test tube 3/4 full water it gave very poor line showing most of the lithia dissolved in the alcohol —

This is a fine way to get last traces of LiCl out of final products (12) alcohol which dont dissolve but traces Na + KCl or other things —

I still have the lime sludge & will acid elute it with HCl & see if I can get more out,

On Dec 28 5.30 pm plenty HCl

I find at 12 noon Dec 28 that the sludge water is entirely too strong in Lithia, and that the original ore was not exhausted of Lithia.

The Original ore should be finer ground and exhausted 2 or 3 times without an amount of acid to be determined, I think there was not acid enough to start that at least 15 cc 37% HCl

No 4

should have been used in the first place, or perhaps 10 cc & then filtered & washed & then 5 cc more put in for couple days — & finally ~~the~~ the whole limed, with unequal ones in or out, this is to be determined —

The 1st Crop of Carbonate Li weighed 1.560 —

Second weighed 0.164

90.5% 1st 9.5% 2nd with more mixed

The question is how pure it is — 2pt shows good line,

1st Jany 1919 –
9.30, filtered off solution about 250 cc cant get any Lithia line This is 2nd leach
Saved residue as no longer giving Li –
11 AM 1st Residue made acid by HCl
1130 am – fairly good Lithia line –

10 30 am Jany 2" dont get any line of Li in 250cc of 2nd filtrate strong with HCl
This is OK

Evap down water extraction solution to 100 cc – ~~[illegible]~~ poured off all but 20 cc – diluted this till 400 cc when line very faint & like 31 mlg Li ~~[illegible]~~ in 250 cc – ~~Equals 1000 cc solution~~ 1/80 of the Li total –
The acid solution had to be diluted to 1000 cc to be as faint as 31 mlg standard according to this water solution
see page beyond

Some (?) mixed

16 = Lepidolite
2 leaches only

Fusion of 25 grms Lepidolite 25 grms Plaster Paris 25 grms Salt, Fuses easily to thick viscous liquid – Kept it fused 20 minutes Top Crucible below red, put top & Crucible in water dissolved all out Evaporated water & mix down to dry and ground fine –

This sample totals 30 grms 10 salt 10 lep 10 plaster paris supposed to leach in water only

On hot plate Dec 31 noon
LOST = 1/4 of water over boiled & slopped in flask because cork in too tight, will run it anyway

only took out 1/2 which is bad. perhaps blunder do something in this as a reason for poor showing as compared to good which has none

Probably wants Lining before Water Exhaustion

The Original water solution in 200 cc Took 20 cc & diluted it to 200 cc then discarded 100 cc & diluted the remaining 100 to 200 cc = 20 times dilution

Lime pest acc line with less than 31 standard

1/10th –

Something Mixed as I record already tested Water Sol

I think I notice that filtrate (2nd) was much stronger when fresh & it may be dri reverts – however its unpalatable

1030 am Jany 2 – scarcely get a Li line with the 250 cc 2nd filtrate cooler ~~[illegible]~~ with complete HCl – This is OK

The water Extraction has 12 times more Li than the final HCl Extraction in fact this seems perfect if the Spod hasn't a lot locked up that will not come out by prescon & acid –

The acid solution after all night diluted to 500 cc just faint Li line, & this lifted I think I would have got out by boiling water –

17

Duplicate of 16 – Except its Spodumene

On hot plate Dec 31 noon
1st wash filtered off 6.30 pm 31st
Jany 1st 9.30 am filtered off solution 2nd wash been in all night, scarcely get Lithia line
Dried Residue, as no longer gives Li by H_2O

2 Leaches only – now evap to dry

11 am 1st Residue made acid by HCl

1130 am weak Lithia line –

As 16 17 + 8 after extraction with water fully – the acid brings out more Lithia, this shows proportions of $CaSO_4$ + salt not quite exact, it wants longer fusion perhaps to act on all the ore also possibly finer grinding –

17 Continued

The final water after Evap to dry was dissolved in minimum water but left a residue ~~that~~ after filtering - the water was more than simple to decation the alkaline -

This water 100 cc was diluted to 1000 cc Line fine

(500 cc set aside)

Remaining 500 cc diluted to 1000 Line good, (500 cc of this) was set aside,

Remaining 500 cc diluted to 1000 cc - (500 of this set) aside, the remainder diluted to 1000. This gave very weak line. Fragile

Deke 31 July Standard

#16

1030 am, get a faint strong line in final washer of 2nd filtrate strong with HCl — well see if some present of di

The acid HCl from residue after thorough water Extraction, diluted to 2000 cc line fair — Took 1/2 away & the remainder 1000 cc & withdrew 500 cc or what is same thing took 1500 cc away or 3/4 Then diluted the other 1/4 500 cc to 1000 which gave line almost like 31 Mg standard in 250 cc.

This seems poor & its probably fluorine or not Enough gypsum to take care of fluorine —

over

18 -

Dup of 16

Except Ambligonite on hot plate Dec 31 noon

1st wash filtered off 5 30 pm -

2nd wash filtered off 9 30 am January first 1919

~~Will get residue back for a 3rd wash as it shows a pink back distinctly~~

Cant get a line in flume after 2 small after washes of residue

2 washes takes practically all out -

11 am 1st Residue made acid by HCl at 1130 strong Li line

Took the water Exhaust Col
200 cc
abstracted 150 cc
50 cc diluted To 200 cc 25%

Abstracted 150 cc
diluted the 50 cc to 200 cc 6 1/4%

abstracted 150 cc
diluted the 50 cc remaining
to 200 cc this gives
line a little darker
than 31 mg 250 cc standard
1.53%

Fused 25 Lep
12 Cluster Pains
12 Salt
12 Lime

It dont fuse to my cons liquid
just fruts — Think that would
do —

Will try 25 Lep
25 Salt
12 Lime

19 = Jany 3rd 1919

25 lepidolite
25 salt
12 quicklime -

Took 25 grams of this mix which gives 10 grams of lepidolite.

Add 10 grams Caustic W Va Lime in addition -

200 cc water - added lime after mix was hot.

When putting in lime boiled over + large amount of mix lost

20 = 1 + 2nd washed put together
evaporated down to 340 cc —
+ diluted by 10 sections of 340 cc
each total 3740 cc
when the line was about
same strength as standard
solution of 62 mlg LiOH in
250 cc water —
15 times weaker
This would give 930 Mlg
Mlg LiOH. —
The solution has HCl put in,
186 lbs LiOH, to Ton —
1/2 hour after HCl in the residue after
2nd Exhaustion, could only get
a very v faint line
Boiling 1/2 hour goes neutral — & add
more HCl & boil again —
With 125 cc scarcely see line
much less than 31 mg standard
LiOH practically all out on 1st wash
all on 2nd, 3 lbs left [illegible] on 2%.

This is OK & does
20 — the business for Lep
mix
25 Lepidolite
25 Salt
37 Plaster Paris —
200 cc water — in beaker

after boiling add gradually
10 grams W/a quick lime
probably be better slake it to mush
& then put in as piece 1/8 @ 1/4 don't go to piece
1st filtration, about 250 cc shows
very brilliant line — not all out
yet by water 1st filtration still going
on —

2nd filtration 250 cc Count 200
line — When Evaporated
down to about 150 cc can
just see it Extremely faint —

fused at yellow with whitish
aspect, about 1 hour to like
Summer butter

No 20 — work for

Lep —

Ton Lep 200 mesh or finer pre previously ignited ??
1½ Tons Plaster P (or semi dehydrated) gypsum
1 Ton Salt,
all mixed and blended till thick pat — fused to yellow white for say 1 @ 1½ hours —
~~[illegible]~~ Now we put in water to get out Crucible and dried the water out,
then pounded it 200 mesh and Leached ~~after~~ adding 1 ton Caustic Lime & boiling

Hence raw materials

1 Ton Lep
½ Plaster P or say 2 Ton Gypsum
Ton Salt
Ton Caustic Lime —

Possibly can reduce these quantities,

10 amblygonite - Muffled & grounded
then powdered & fused
in HCl - with just enough water
to cover over the Lamp bulb
& 1/4" above, for 6 days -
got Li Line detected with
20000 cc as quad or
62 mlg in 250cc standard &
yet all of the solution not filtered
out of ore -
There is something wrong as
this would be 900 lbs in 1
Ton - Its probable the
standard is wrong & not
really deep Li OH.

It needs to be vigorously boiled probably to increase crystallization possibly some better separation is funished by boiling as Iron floats to top with a froth & that filters clearly

Took Residue & washed it then filter & boiled it 20 min refiltered & washed several times hot water till no line about 300 cc water this only shows lime faint

Will treat residue with HCl — in excess after boiling 1/2 hour get faint lime like 62 mg standard, about 250 cc water + HCl — Spod 21 is little stronger than analysis No 22

No 21

Quenched Spodumene, then ground fairly fine & mixed as follows, fused 1 hour at yellow white. —

25 grms Spodumene
25 Salt
37 gypsum
87 — Quenched water & whole soap to dry & powdered very fine —

Weight 76 grams lost 11 grms or 12.67 % lost

Spod dont filter as fast as Analysis of 22

Dont blue red litmus or redden blue litmus

Final Residue treated strong acid all night, Lumed diluted to 800 cc to equal 20 mlgm standard CaOH 250cc —

OVER

7000 cc Equals 20 Mlq Standard
Equals 112 lbs di OH Tan
[illegible]
Yield 90% by Water
If fired 2 hours thick wood
get 95% or more

It's necessary to vigorously boil for a couple hours long boil any dil Cl for 20 minutes — filtrate clear now some chemical reaction for the better takes place or circulation is more rapid —

Took residue washed it thru filter & boiled it again — for 20 minutes — about 300 cc good lime after washing reaction on filter or immediately after lime till lime disappeared entirely —

I will not treat residue with HCl — in excess don't think much left

after boiling acid ½ hour get a lime faint about like 62 mg standard — about 250 cc liquid or less

22

Ambligonite done same as 21 but

25 ambig
25 Salt
40 Plaster Paris —
90 —

Weight 75 grms lost 15 grms
15.6% loss

fillers better than 21 —
Changes neither Red or blue Litmus —

I diluted the water filtrate with 10000 cc when it was about equal in brightness + drying away time for 2 drops of Pelinson 20 mg LiOH dry in 250 cc acidulated with

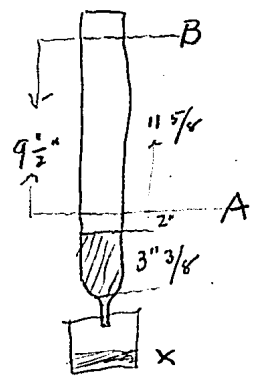
HCl by me, [illegible] Water
Equals [illegible]
Equals [illegible]
I now find it wants more water
have put in 13500 CC
to Equal Standard 20 Meq 250 cc

This is 54 times stronger which
gives 1.080 grms in the 10 grms
of ore, multiplied by 90000 times
gives 97200 grms or 216 pounds
of Li OH dry Extracted from the
ore by water —

The acid Solution Excess HCl all
night + washed well —
1100 CC Equals 20 Meq Standard
This is even higher Extraction than
#21 Spodumene which appears
to be the most difficult + wants
longer fusing probably
1% left in ore or 93% Extracted —

Saturday 5 pm Dec 4th

Put in a charge of OTE 25 25 37



inside diameter one inch.

Cold water

at 9 30 am monday 6th

found water had gone down from B To A - 9 1/2 inches 38 hours -

filtrate strong Li Line, water coming thru now gives no Li Line

Either I made a mistake in 21 & 22 by taking all of the fusion instead of 2½ times less or less yield due to not grinding fine before fusing —

23.

25 Lepidolite. not reground before fusing — probably 100 mesh —

25 Lepidolite
25 NaCl
37 Plaster Paris
all of this used

Weight 75.070 grams loss 12 grms fused to a liquid, 1 hour bright yellow verging on white —

This is to ascertain if it must be ground fine before last fusing —

at 4000 cc Equals 20 mg per 250cc standard for water soluble. This is for whole of solution diluted to 1000 cc + 400 cc used in test to represent 10 grams Lep 16 Tol
64 lbs Lith.

25) 64.00 (2.56
145
120
150

24

25 Lepodolite.
12 Salt
25 Plaster Paris = all of this batch used

Very dry did not fuse but fritt

Weight 54.12

Loss 8 grms abt,

Put all in Crock — cc
Total 4000 cc + percent
this showed only Equal
to standard of 20 mg
or 25.6 lbs Lith to
Ton — Something
wrong —

25

25 Lepidolite.
12 g. Salt
35 g Plaster P
all of this batch used
very dry – Did not fuse
fritted –
Weight 66 grms
Loss. 6 –

Diluted whole fusion to
7000 cc to match
standard 20 mil/250cc
1 to 28.
per ton.
112 lbs Li OH
about 1/2 comes out,
or is lost,

With fresh lime & CaCl all night found strong lime in morning its been acting on it all night #28 is very much poorer hence it may be fluorine absence in Spod makes Spod work with CaCl + CaO no fusion whereas Lepid of 28 has Fl. & fused & gave its Li —

4th — & all put in Crack 3000 cc gives about Equal to 40 Milg Standard 12 to 1 — 96 lbs LiOH. or 3% ore =

This is less than #28 but this is Spodumene — + all that is necessary is finer grinding + floating =

5th following on — only all night boiling dish pipe burnt in morning cold get lime 20 milg standard well heat to boiling — about 200 cc lime = to 40 standard — abandoned Residue

#26

Jany 8 4 pm

Put 10 grms lime ground Spodumene that had been roasted & quenched, 1

Put it in small beaker with 250 cc water & perhaps 5 grams Calcium Chloride & 6 grms about of WVa Carbide & boiled it till 6.50 pm when I put it ~~with~~ on butter dish + CaCl overnight — I noticed the Lithia Line rapidly got stronger & stronger until the End it was much stronger than 40 Milg Standard in 300 cc — This is 1% out of ore it looks that if lime is given most all LiOH will come out — Especially if ground very fine —

930 am — 240 cc of sol. to 10 cc diluted it by adding 40 cc to get line between 20 & 40 milg standards — probably 30 standard 1.4% out, @ 24 lbs LiOH.

27

10 grms Ambliganite
about 10 grms Calcium Chloride
& 6 " Caustic W Va Lime
Boiling — on flame
burner at 1040 am
Jany 9 =

Been on hot plate about 2 days
on boiler cloth — Now 7 Gal
for 1/2 hour — over flame —
2nd filtrate shows very
v faint —
Hence Ambliganite must
be fused with the Ca + CaCl
using raw N G

Perhaps can get more out on 3rd Run

On 3rd Exhaustion I put 5 or 6 grms of CaCl in water before I did so, got a line in 250 cc equal to 20 mlg standard, after boiling 1/2 hour showing it wasn't all out + must be boiled as all night at 150 nig —

Even after 4 to 6 oz I get no line with 250 cc but the float stuff on top which under microscope is about 1 to 2/100 dia + glassy - gives a strong lithia line in the froth, perhaps it should be fused 4 or 5 hours to get these attacked,

4th - cocakes just get line very faint with 1 drop + 2 drops gives it ok

Shall make a 5th = 7.400, CC

Equals 40 Mlg Standard

See next page

28

20 grms Ore.

20 grms Lepidolite
15 " Calcium Chloride
10 " Caustic Wash Lime

Fused 1 Hour Weight after fusing 41.590
no HCl came off!
I exhaust the whole, using 500 cc + boiling over flame stand —
Dec 9 2.30 pm

Nothing comes out on 2nd washing all night that can see put filtrate with 1st filtrate.

Diluted 1st + 2nd filtrates to 4500 cc where it equals 40 Mlg Standard, perhaps a little better — 18 to 1 — figuring on 10 grms only or 1/2 ~~Got~~ .72 lbs Li Oxide per ton

should be for 3% ore 96 lbs

This for 3700 cc 10 grams ore
is 118.3 lbs Li_2O.
if 3% 60 lbs Li_2O or 96 lbs Li_2O.
if 4% 80 lbs Li_2O or 128 lbs Li_2O.
Apparently the Extraction is
good —

29

20 Lepidolite.
27 Cluster Pacus
15 Crystals Ferrous Sulphate
25 Salt —
87 1 Hour fuse

Weight after fusing 63.430

Ferrous Sulphate had 7 H_2O in

1st Filtrate Strong —
added a little Salt to mix for
2nd filtrate. —

250cc only line less than 20 standard
after cooling in morning —
Have abandoned Residue as
not pleasing —

Equals 40 Mlq Std 4000 cc
pear —

I put the 3rd filtrate with 1st & 2nd as there are probably some Li left in it about 250 cc -

I now put 10 grms MgCl in & boil for 3/4 hour -
got a faint line - MgCl apparently working - will boil longer
Started 3.47 pm -
off 5 pm - with wet asbestos get the line faint showing further action, This is 4th filtrate will put this by itself -
& try 5th boil with Chloride Barium -
ChlB in at 5.42 pm boiling
617 pm stopped & filtered
no line when very wet.
Will filter off - & try MgCl again
after 2 hours poor, 2 drops to get a faint line - put filtrate with big lot
& No Residue added 20% NaOH 2 25 pm boil

8000 cc equals about 33 cc
Standard, 32 to 1 84 lbs
Li Oh per ton - less than 3%

30 See next page

25 Lepidolite not ~~fuse~~ healed in muffle but raw ore - ground & through 100 mesh only then fused
37 Plaster Paris
25 Salt -
87
Weight after fusing 69.960

1st filtrate strong line
2nd filtrate, weak -
both together very strong
3rd after 1/2 hour with added MgCl
no line - I then put in a little CaCl & boil -
boiled 1/2 hour no line yet ~~froth~~ gives powerful line for long time
I will try other things on this residue ~

C913

This is promising ~~+ ore~~
ground 1000 float mesh think
it will be OK — if MgCl be
used, to leach

Still have residue of 30
Running —

Later — I acidified the 8000 cc
& found it equals to 40 cc Eluant and

or 102 lbs Li OH per ton
or over 3%

Residue has NaOH in it
now — 4 pm —

Nothing came out.

~~I have put strong HCl on Residue~~

Now strong HCl — to see if
any Li — after 2 hours
250 cc line probably equals
60 mlq — Abandoned

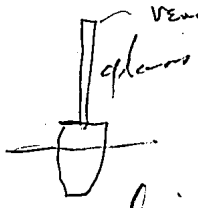
31

20 Lepidolite.
25 Green Ferrous Sulphate
2 Charcoal

1 Hour fusing

Residue weighed 24.320

very near to Lithium



poor line — I will now add CaCl Calcium —

about 5 grms more or less — to see if better — boiled 15 min strong line — about 200 cc filtered + put 4 or 5 grms CaCl in mix for 2nd round —
11th 5 pm for Sunday

last week got faint line
20 mlg Standard 200 cc then
beaker broke & lost 1st part
that run then. - saved that
from 2nd run then but must
be poor — put it with all
the least — The float
in filter gives strong
Lithia line —

3750 CC Same as 40 Mlg

120 lbs

nearly 4%

& I lost some by
cracked beaker
on heater & also by filtrate
beaker —
just for fun put precipitate back
on hot plate for the night —
after 15 hours more get a 30 line with 850 cc but
mud gives much more brilliant line than 33 where
$MgCl_2$ used — My Conclusions in that line

next page

10 grms muffled Epsomite
not fused in little Crucible —
10 grms Lime Caustic
W Va — Nothing Else —

250 cc 1st filtrate strong line
& stays long time probably
$LiOH$ + not Chloride —
This is strange —

Sunday night sometime
bottom beaker cracked & all
sol lost but most of ores
in — put fresh water
on 9 30 13 June
June 15 on all day + night —
2nd filtrate — line better than 40
I put it back on plate for 3rd filtrate

must have $MgCl_2$ or other Chloride to harden the leaching all the time will do it with Lime alone on spot —

Note

I am pulling the mud back & use some $MgCl_2$ to see what next soak does —

4000 cc, but not so strong as 40
3500 is about 40 standard

Last leach taken off 4 pm 17th find better line than 40 with 200 cc — 500 cc not so good —

Think 3750 cc is Equal to 40 — mud well and HCl faint with ACl still pretty bright shows not all out —

Abandoned

to Lott for assay

Weight of Mud Lime & ore
20.5255 grms —

Ott took 1 grm assays
chocos 0.858% L_2O slice
left in ore

This is four as ore was not floated

LWS

I put in about 10 grms what I suppose is chl Mg from made Evap desh on L Otto Table, it gave strong line of Ca —; ? Is OK to put on all night direct on hot plate

200 cc stronger than 40,
15 Dec 5 pm
~~with~~ put residue back for another with more MgCl —

~~[illegible]~~ at 2 pm next day 16th 300 cc found very strong line, been dried on hot plate - glass was lost only little H_2O by evap —

Shows must boil with reflect Condenser for several days or when very fine float 1000 mesh say Hot 3 or 4 days when I think all will come out,

See page 00

Not fused

33 Jany 13 -

10 grams Spodumene —

Not fused in small Crucible

10 grms Canada Lime —

Set aside 11th Jany 5 pm to work at ordinary time being most sol in Cold water —

15 hours cold 250 cc barely get line, evidently requires heat
Jany 13 9.50 am put on hot plate direct —

((by mistake I put 10 grms MgCl in it — after half 4 hours

Jany 14 3 pm - 250 cc very strong line -
Again put more MgCl - get line again " MgCl get a line — ~~will put it away (Results) for night as have no room~~
~~MgCl~~ —

I put it back on hot plate with 2 grams of $MgCl_2$ for further soak as the float mud still gives good lime —
on 3 30 pm 16th —
17th 9 30 am - about 200 cc lime
about 30 - float stuff gives strong lime -
I suppose it will come out slowly but too much time would be required
I will now determine the Total cc. of all washings

NOTE = The residue is now Slimy - very slow to filter
will have trouble here in factory process —

4000 cc is just as good as 40 standard -
16 to 1 640 mlg LiOH in it
128 lbs - Exactly 4% Li_2O in ore
got out
This is better than 32,+ is due to $MgCl_2$
but is not very much better,

I save the slimy residue
dry it & see what can be done to get more out as slime shows strong lime right in flame

Continued - OH assayed the mud residue -
Weight of total residue 21.76 grams
LiOH using 1 gram of the mud. got. 0.835% Li_2O.
in ore,
This is not floated but was fused in small crucible —

(4.)

Not found

34

10 grms Opodeumene

About 15 grams Sulphate Magnesia

Jay 14 3 pm frothy up

200 cc not equal to 40 — abandoned

36 - not found

10 specimens
about 15 grams Mercuric
Chloride -

Jany 14 3 pm -
Dark all thru liquid
ng - 150 cc filtrate only
get 40 lines - abandoned

1st filtrate 5 pm 16th 350 cc very strong lime
+ further washing quite strong lime —
100 more cc — then weak.
Now on 2nd leach with 2 or 3 grms MgCl —
decant on plate 250 cc water —
5 20 pm —
off. 10 am — filtrate 300 cc about 40 lime
mud shows dull lime — dilut by with HCl —

Put residue back with 1 grms $MgCl_2$
+ balance of Lime
at 11 am 17th — for 3rd leach —
but think there is very little left —
I think 50% comes out with less
than 1/2 the $MgCl_2$ + Lime
I leave 3rd leach on all
night, beaker 1" of Top
3rd filtrate, 250 cc = to 20 standard

All together 3000 cc about
Equals 40 standard — of anything
is weaker than 4° mud with HCl —
not very bright, think got 90%
off all in it + LOH was among
final residue —
Think it may have reverted
as it was 24 hours cold

37

LOH — Concentrated residue after
fusing + exhausting gives about
10 cc with poor lime — 99%,
This is perfect exhaustion

10 grms floated Lepidolite

White poor quality, brot to yellow in
muffle, quenched in water, ground +
floated — till all about 1 to 1½
thousandths in diameter

Total Lime to be used W Va Carbide
10 grams only a little at a time
used, Also 3 grms $MgCl_2$
used only little at time used,
about 100 cc water maximum

On 3.15 PM — 15th ½ grm MgCl 1 grm
CaO —
at 6 pm put in 3/4 of the Lime
+ 2/3rds of the $MgCl_2$ + increased
water to 200 cc set on
boiler plate for all night —
at 2 pm 16th took off boiler decant put decant
on plate, 4 pm added a little $MgCl_2$ + lime —

2nd filtrate Couldn't get lime Except
Extra drop on asbestos —

3000 cc about same as 40.
may be a little weaker

This is best
of LOTL fusion of
residue & Smith
Method, first filtrate
10 c only dull lime
shows 99% Extraction
of Li by this process

38 LOTL Concentrated filtrate
from fusing residues —
10 cc lime dull — ~~[illegible]~~
~~[illegible]~~ perfect Extraction 99%
Lepidolite floated Exactly as 3

10 grams Lepidolite
10 grams Lime
5 grams Chloride Calcium

The lime ½ & CaCl ½ put in with
ore for 1st soak — 250 cc water
Jany 16 6 pm on hot plate direct.

1st filtrate 11 am 17th —
put residue back with
some CaCl + lime for 2nd
leach —

Mud gives weak lime after washing
well — with HCl on mud gives fairly
strong lime — showing not all
attacked —

I think 80% comes out with lean
liquor ½ the lime & $CaCl_2$ —
2nd leach on 1150 am — stays on all
night till 18th beaker 1½" of Tops

CRT

as 40 standard appears better a little than #37 —

39

10 Lepidolite like 37 —

10 Lime —

10 NaCl —

250 cc H_2O

only about 1/2 of lime & salt put in on 6 20 pm dec 16 on hot plate Dec 16

1st filtrate off 1130 am —

Mud without HCl gives no lime — with HCl — strong lime, showing all not acted on —

I think 80% comes out with less than 1/2 the lime & salt

2nd lead on at 12 noon — I leave it on all night till 18th —

3rd filtrate, 300 cc concentrate get lime — put all filtrates together it appears 3000 cc is as good

CIRC

Note =

37 38 + 39

appear to all have the same strength should say each was close to 3000 cc with a line a little less than 40 mlg dry LiOH in 250 cc standard

2750 cc would be certain = In all cases I acidulated the filtrate with HCl before testing in spectrum

It is possible that neither $MgCl_2$ $CaCl_2$ or NaCl is required to get the same result, with Lime Caustic alone + the product will be the Lithia hydroxide Caustic

2nd Leach I put in 2½ grams more of lime being ½ or 5th gram so far —
3rd leach put in all the lime —
on 3 hours 250cc lime better than 40 — This shows must have Enough lime at first to fuse Combine with all the SiO_2 Al_2O_3 + Fluorids + some Excess
Now on for 4th leach —
all night direct on plate —
300 cc —
4th 250cc lime about 30 —
filters slower than usual but may be due to fact I allowed it to Cool down to determine settling point

Phenomenon = An Electrolyte with Solution seems to hasten the Exhaustion. See 37-8+39 —
probably only a little is required = Later Chlorides increase Solubility of lime
Now on for 5th soak — get lime
All put together 3000 lime
not Equal to 40 standard should say 30 only — showing not all acid must have Chlorides for rapidity

40 — There is no doubt we must have stirrers in tanks but they can go slow To prevent incrusting bottom + also the keep each particle in saturated lime solution

10 grams Lepidolite like that used in 37-8-39 — fluxed 1000 @ 1500 mesh not fused in little Crucible but ignited + quenched
10 grms Lepidolite
10 grms Lime if necessary
Nothing Else —
On hot plate 6 pm 18th
250 cc water + about 2½ gram of lime to start it —
1st filtrate 10 AM 350 CC after HCl. good lime —
Noticed large amount hard at bottom in practice must be stirred by plows

No 40 with 10 grms Lep
+10 Lime - 4th Extraction
after taking off was allowed
to settle down, in 15 min
it settled in beaker so white
float occupied 6 sqr inches
This is about 312 Cubic
feet per ton of ore & ton of
Lime -

The bulk of ore (float) for 10 grms
Dry occupies about 1 inch
the unslaked dry Caustic Lime
about 1 inch 3/16 inch -
+ the mud of the Leach
will probably settle
to 5 @ 6 inches - (ie) the
dry ingredients finally
settle to 3 times their original
Dry bulk

41 -

10 Lepidolite
10 Lime
1¼ inch — Water — in beaker, lime slaked

Cold Leach

on 2.30 pm Jany 22 —

First water used 1¼" in beaker was hot Lep 10 Lime 10 all together then water then slaked Lime — Now allowed get Cold & Continues —

Tested Feby 9th 200 cc
Not equal to 40 —
Cold dont work —
If heated hot under say 50 lbs it would go much faster Heated at 212° not Hard

Σ

(1335)

10 Lep
10 Lime
Minnamam water to slake lime
Put on plate on butter dish –
Jan 22 2.30 pm –

10 Amblygonite Floated —
10 Lime
Beaker full water for night run

5 30 pm — Jany 22

1st filtrate of 1110 cc — ~~follows~~
~~water above clear 1 3 4 5~~ —

2nd filtrate —

No lime at 2000 cc

NG —

Lime itself NG on
dmbleq

I put back residue
& put 5 grams Barium
Hydroxide in it at
4 30 pm
2 hours no line visible
abandoned -

43 -

1000 mesh

10 grams Ambliogonite (floated)
10 " Lime
2 ½ grams Calcium Chloride

Full beaker for all night Leach
5 30 pm - Jany 22 1919

1st Leach - filters fairly well -
not so fast as Spod or Lep but
good. its finer & more gelatinous
off 10 am Jany 23rd
on for 2nd at 1150 am
23rd off 10 am 24th
all filtrates - 2000 cc equals
= 40 NG -

CaCl shows better than
Salt or MgCl for
curbing & probably
on Spod & Lep

10 grams Ancleligsuite floated
10 grams Lime
2½ grams Salt NaCl
Beaker full water for all
night leach

5 30 pm — Jany 22 1919

1st filtrate - filters very well
not so fast as 40 or 45 p it
fewer + more gelatinous
off at 10 am 23rd

On for 2nd at 1050 am 23

2000 cc weaker than 40
probably 30 NG

45

10 grms ambligonite floated
10 " Lime

2½ grms Magnesium Chloride

Breaks full water for
all night bleach —

5 30 pm — June 22 1919

1st filtrate off at 1115 am +
filters slower than 42-3-4

2nd at all 2000 cc

~~Sto~~ Very faint Lime MG

46 -

Spodumene floated
1000 mesh

10 Spodumene
10 Lime
1 gram Cane Sugar
On at 2 30 p.m. - July 23 -
1st pass line - Good work

(157)

47

10 Iodum, floated
10 Lime old WV not lively
1 gram glycerine —

This has a fairly strong line, ~~[illegible]~~ lasts to 3 times stronger than 46 & may be something in it — it was semi caked together so whole balloon moved about inch high in beaker — weight very hot all night as I turned steam down a little & set beaker on slope

out 10 am —
all filtered - 2500 CC
same as 40 mlg
There is more in milk
not well exhausted too cold
all night —

Shalers Lithia Water all
night with Lime but always
no sign of being attacked—

48-

10 grms anthracite - floated 1000 mesh
10 " Barium hydroxide -
2 ½ grms salt,

On in 250 cc Jan 24 - 3 pm -

This is not equal to
2000 cc 40 slum
Run passed -

C1017

49 =

Note white float dont seem to settle down in 4 hours it might in 24 —

Put it back on hot plate for hour then filtered it & washed till got no lime —

Diluted to 8000 cc the line equals 40 mlg standard & probably a little better —

I put residue with 5 cc more HCl, back on hot plate to see if more comes out, Saturday 6 pm 25th

3 pm 26th = 250 cc line not so good as 40. so practically got Lithia out on the other breakman's

What's needed is fine float & agitation by stirrer while leaching — possibly grinding on bottom, or a separate

most important if open final results

49 — OK Process

10 ounces floated
15 cc HCl
2½ grams oact
250 cc Water

300 cc strong line — there is lot white float makes it filter poor not 1st drop by drop — only filtered a little put it back for the night 6 30 pm 24th = Looks as if stirrer was necessary otherwise each particle coats with an impermeable coat & stops action —

took out residue & ground it in agate mortar then put back on all the filtrate on hot plate

Now determine
Minimum HCl — dilute 5 cc + H2SO4

50 –

10 Anthraquinone floated
10 gms Strontium Hydroxide
2 1/2 gms Salt –
250 cc Water
on July 24th –

filtered 1/2 goes thru clear
shows pretty good line
3/4 hour on heater –
On 6 pm 24 for all night

Even after grinding
in Mortar only 2000 cc
as good as (40 mlg standard)

[165]

51 = will put the 2nd leach in when ready & determine —
Hole got in beaker lost some say 15% of residue
all together —

7000 cc = 40 —
Think H_2SO_4 as good as HCl — & lost some
H_2SO_4 will work OK

51 =

10 Amblygonite floated
15 cc Conc H_2SO_4
250 cc water —
on 26th 4 30 pm —

off at 10 am 27 = filtered & ground residue — put on hot plate 11 am 27 — with 5 cc more H_2SO_4 Conc was not much residue & that was fine — had fine white float acts same as HCl — Diluted to 3000 cc strong line 27 sec — had use spat to bring out lem

52

The mineral precipitate on particles does not break away to allow fresh action when stirred this way — it does better than still — would in time do the treatment

I am now making a leacher like the old washer pan with 4 shoes rotated grinding on the bottom of the pan — I feel sure this will solve the problem —

52

10 amblig floated

10 W Va Lime —

½ put in at 1st —

beaker has 3" water.

on hot plate with rotating paddles to keep it agitated & grind off reaction film

On at 210 pm = 27 m —

[illegible] = 40

[illegible] of [illegible] to [illegible] = 4250 4

OR

2000 cc lime not equal to 40 mlq standard —

53.

10 grms Felspar (Trenton) Floated
10 " WV Lime Caustic -
200 cc aq Hot plate at
9.50 am - 28 Jan

~~10h [illegible] to [illegible] at~~
~~Chef or stock [illegible]~~
~~[illegible] to bottom = [illegible]~~
~~[illegible] broke [illegible]~~
~~lost~~

(170)

54

10 ambliq floated
5 grams 66° H_2SO_4
200 cc aq
11 15 am — 28th
acid too weak
burst beaker by bumping
lost

55

10 amblygonite flooded
7½ grms 66° H_2SO_4
200 cc aqr
1115 am Jany 28

Acid was too weak
bumped in night &
lost.

56 =

250 cc no line ~~of~~ 2nd filtrate

I then used 1st filtrate

+ had to dilute it to

9000 cc ! & got

line equal to 40 Vol Standard

This shows Ton of ammoniac

will be exhausted by a

Ton of H_2SO_4 — I now must

see how much less will do

it — ! I acidulated the

9000 cc filtrate with some HCl.

dont know if it was necessary

Phenomenon

Ok process

56

10 ammoniacal —

10 grms 66° H_2SO_4

200 cc aq —

1115 am 28th

Acid was strong enough

to prevent bumping

+ it was OK at 830 am

29th —

Notice that filtrate runs

clear even on start of filtering

Strong line 300 cc — Residue

I put 15 cc 66 H_2SO_4 —

Equals 9 grams by weight I

think as there is considerable

residue — back on hot plate

915 am —

10 grms Lepidotile fluated
10 grms Chalk ——
$2\frac{1}{2}$ grms about $CaCl_2$

only little comes out, 300 cc = 40

58 =

floated

10 Ambliqenite
15 Chalk
5 Chloride Calcium

Only little Coma
out, 500 cc = 40

C1817

59

About 10@15 grains
Glucoside not powdered
the clean green
10 Lines -

60 -

10 amblygonite floated
10 Lime
2 ½ Calcum Chloride

In grinding Pan leaches
2 15 pm - Jany 30 1919
Stopped for the night heat
off - started again 31st -
off 6 pm - filtered -
about 2 pm I added 5 grms
more of slaked lime -
fearing 10 grms might not be
enough -
It filters OK - ~~Residue~~
dark from iron I suppose
Total Water was about 400 cc
only 2000 cc Failure
Perhaps must have big weights
these small ones destroy group -

(115)

61

10 Ambliqonite floated

S: 20 Lime.

5 $CaCl_2$

S: 850 CC water

on 9.30 am 31 January 1919

to see if action will go on further than 1/3rd as heretofore,

" at 10 10-qot lime = 20 kilg-

Very poor froth 10 cm —

Put in 15 grams Salt-

62 –

fine ground Glucoride, green,
not floated –

9.360 grms –
10 grms Lime –
2½ Salt –
250 H_2O –

on 230 pm – 1st 7s6y

It only takes out very
little, – 1/8 of what
it should must be
Combined with the
Iron somehow

C109

Notebook Series -- Notebooks by Edison
Notebook, N-18-12-26.1

This notebook was used by Edison in December 1918. Included are notes summarizing experiments with various CuO electrode plates and giving cursory descriptions of experimental cells numbered from 13 to 16. The front cover is labeled "Dec 26 19/18 Copper Battery." The pages are unnumbered. Only seven pages have been used.

Dec 26 Noon

So far CuO Thru 180 mesh is best it shrinks 58/1000 in 2.287 dia which is more than coarse CuO as they use it for plates at the factory This only shrinks 5/1000 in - 2.287 dia disc.

4 grams of Lead glass thru 200 mesh is OK it should not be coarser as that would require more glass to give the same strength The addition of 250 Milligrams of dried Soda + 5 cc H_2O (Caustic) to the 4 grams of glass makes it more fusible and permits of baking at a lower heat, a little brighter than Orange is OK see Nos 7 8 9 cell records

Also as shown by No 12 Cell Ordinary bottle soda glass Can be used, 4 glass 200 mesh 5 cc Water 250 milg dry soda But baked at Bright Yellow is OK but it hasn't the Bake Margin of Lead glass

Dia of Mould 2.287

Dia 4 discs Deke #13

	Thickness
2.214	446
2.230	448
2.229	448
2.238	451

Shrunk 58/1000 in 2".287

Probable Cause of great shrinkage: temp so high glass either melted or got too soft —

Battery 13.

100 CuO, through 180 mesh,
4 grms Lead glass, 250 mlg
dry soda 5 cc water.
Baked to full yellow rather bright
Cake shrunk 58/1000 -
probably because it was heated
a little higher than 7 & 9
of old book — This is a
caution not to go too high as
a point is reached where there
is a sudden & great shrinkage.
The holder should be constructed
to take care of this — otherwise
thermometers needs have to
be carefully watched —
if baked lots low temp plates
will not be so strong

This cell is to be discharged at
600 Milamp rate at ordinary
temp, ondischg 11 30 am —
Dec 26th —

#14 – Dup of 13 –

#14 – Dupe of 13
Did same time

#15 Dup of 13 but
run at 200 Milamp in
ice chest
on Dec 26 11 am

#16 Dup of 13
but discharged at 600 Mula
in Ice chest
One Dec 26 11 am

Notebook Series -- Notebooks by Edison
Notebook, N-19-01-01.1

This notebook is a continuation of N-18-12-26.2. It was used by Edison during the period January-February 1919 to continue his experiments on processing lithium ores, including lepidolite (lithium mica), amblygonite, and spodumene. The experiments probably relate to Edison's use of lithium oxide in the electrolyte for storage batteries. The entries describe the reagents used to treat the amblygonite or lepidolite and note the presence of a lithium "line" as indicated by a spectroscope. One entry provides an extended description of a "factory process" for spodumene and lepidolite "in case any accident occurs" to Edison, who was about to leave West Orange for his winter home in Fort Myers, Florida. His description includes instructions for processing a ton of ore, as well as a suggestion that the ores should be purchased along with a mine "for reserve." The front cover is labeled "Lithia 2." The pages are unnumbered. Approximately 30 pages have been used.

63 -

10 Ambly floated
5 Magnesium Sulphate
at 1st - only -
On 1130 am - 3rd

Hardly any lime
I now put 10 grams
Lime in
4th 11 am poor lime
25 sec with H2O -
abandoned

C13

I will make a Deep north
15 grams — as only 3 grams
here which is extremely
unaffordable.

64 -

10 ambly floated
3 Magnesium Hydrox
only at 1st — 3 pm 3rd

No lime —

Put on hot plate all night
July 4th 1030 am.
Can see line for 100 sec
This shows Mg hydrox acts (no HCl)
as a base like Lime but on
account of poor solubility
acts much more slowly
50 sec with HCl & followed —
put back on plate 1030 am 4th
after filtering off & saving 1st
filtrate —
with ~~chlorine~~ (HCl) get slow line
disappearing 30 seconds — This
appears to be working

65

10 ambleq - floated
3 Mg hydrox
2 Sulphate ammon

only got dull line -
Count 33. acc
put some HCl in it
250cc -
~~Y~~ Y leaves on all
night. by mistake not
put on hot plate, now on
Jany 4 12 noon
gets given dull line - Not good
Y guess Abandoned

(5)

This is best yet with
10 000 cc get a
considerable better line
than 40 mlg/250 cc
standard –
The residue is considerable
What is the reaction.

Total residue in 10000
cc after Evap
[illegible]
Very small

66 –

10 grms Ambly floated
10 grms Soda Chloride –
Very strong line
but not so strong
as 69 – as no chloride
counted 200 seconds
& still running –
on all night
Jan 4 12 noon, strong
line, now following

67

10 cubic floated
4 grms Sodium Hyposulfite
250cc after 4 hours
not strong line but
Count 18 before
disappeared —
I leave all night
on plate, 5 pm 3rd
Jan 4 Cant even get a
line — Count worse
Abandoned

68 =

10 ambling floated

1 gram KOH –

10 Lime –

without HCl get rather dull line 200 seconds but with HCl – bright line only 30 seconds showing rather poorly

250 cc on all night

Jan 4 12 noon 150 ~~bright~~ dull without HCl 30 seconds with a bright

ng – abundant

6000 cc equals 40
this is not as good as
HCl or H_2SO_4 - Either
gave 9000 cc
But $FeCl_2$ was more or
part ferric & decomposed
2nd wash filters so
slow that there is 50 cc
not passed thru when
I put water in filtrate
but lime is dull —

69 — FeCl seems old & decomposed when dissolved by precip —

10 Arsenious } S. } Chloride
10 Ferrous }

Very brilliant - Counted
200 seconds & line still
strong. 250 cc —
Line still good at 200
on all night.

Make some good Chloride
+ try def ammonia —
Jan 4 11 am - line just as strong
filtrate Neutral ! !
Saved filtrate & put residue
back on hot plate —
2nd filtrate slimy almost
impossible to filter 250 cc
40 Line or better

showing that of time was grown on account of slight solubility of the oxide. The whole could probably be got out.

This is better than Lime, Barium or Strontium or any of the other Combination of Alkaline reaction & 100cc work

of course the way I use it much of the oxide must be Carbonated,

70.

10 Ambliqonite floated

11 gram Magnesium Oxide –

Water blues Litmus right away – on 6pm 5th

930 am Jany 6 – gives good line put back on plate 940 am 6th – with the 750 cc 1st & 2nd filtrate with HCl get 38 seconds line –

4th filtrate, faint line with HCl – now in Foley 8 10 am for 5th French –

Sunday 9th Feby put all together & got 4000 cc but last 18 hours soak filtrate was very strong line

(15)

71-

10 amblygonite floated

20 grammes Magnesium Carbonate

This also blues red litmus paper but not so much as Oxide —

Mg

Idea is to get HCl.

72

10 cc Belgonetic floated

10 grains Magnesium Sulphate

10 " " NaCl—

Thereafter ½ hour is not slightest acid. + unlike 73

15 hours more neutral

6000 CC—

to make HCl

73 -

10 Ambly floated
10 Ferrous Sulphate
10 NaCl.

This quickly becomes very slightly acid -
After 15 hours slightly acid
after 30 hours very strong
line 250 cc - Odd absorbent
fellers good -

Only gives 6500 cc Equal
to 40 mlg standard —

I added 1/2 & Evaporated it down — Residue not over 1 grain — 5 5

Wonderful

soda alum or Mag sulphate or H_2SO_4 good for ambiguole

10 Ambiguonite
5 Soda Alum —
shows acid on litmus

after 15 hours I find it is not acid —

gives fairly strong line at End of 400 seconds no acid — 200 cc

Took 1/2 of filtrate 1 + 2nd and it required 5000 cc to equal 40 or total 10000 cc

This is as good as 10 alum & shows 5 alum is enough

75

10 grms Arabica floated

10 grms Sulphate Aluminum

This brake

as I put reader back
+ forgot it –
I filtered it, of course to
only water but
250 cc better than 40
probably 400 CC
more which would
be 8400 CC

10 milligrams floated
7 = grams Sulphate of
Aluminum —
In 20 minutes after
pulling on hot plate.
I filtered a little at
once 200 seconds.
with 250 cc in beaker
then as going down
1st filtrate filters good —
on ~~20~~ 20 hours –

8000 cc Equals
40 mlg – dont think
got all out – time too short

Must now decide between Alum & Sulphate Alumina alone — Costs & time — to determine as well as residue in filtrate —

or H_2SO_4 or MgO or Dolomite

77

10 ambly floated
2½ grains.
Aluminum Sulphate

after ½ hour on hot plate
250 cc its acid to Litmus
Friday 7 4pm —
Friday 8 10 am slightly acid
good line —
filtering — filters rather
slow but clear —
2nd batch for 3 hours, get a line
filters very slow —

About 6500 to 7000 cc
Equals 40 Mlg Standard

78

10-Lepidolite -
10 Soda Alum

for a quick test,

In case any accident occurs to me following process will work on a factory process for Spodumene & Lepidolite -

Break up in Crusher to 1" or less the ore, bring to yellow & then suddenly quench in water - Draw off water - Dry ore & Crush in ball mill Etc to very fine powder - Pass this thru pan & Classifier & only take the ore of float that shows under Microscope to be 1/100 of inch diameter - The other ore to be dried & reground - Grind dry as wear & power tools more than drying if wet crushing is done -

for Lep & Spod - use about 1 Ton Caustic best grade Lime to Ton Ore, Use several iron tanks. Each holding Ton of ore with stirrer which can go as slow as 5 Rev min to keep from Caking on bottom

heavily lag sides top & bottom with Regulation lagging but Extra heavy put Canvas over & heavily paint to keep water of lagging.

Have a set of tanks, after say 3 days withdraw the mix to a filter press, & pass the filtrate to 2nd tank & break up filter Cakes & put back in 1st tank - after ~~3 days~~ put fresh water in 1st tank & after say 3 days filter press 2nd tank - the filtrate going to 3rd tank put Cake back in 2nd tank after press 1 tank & put filtrate in 2nd tank think 3 washings of 1 tank will Exhaust it & so on the original solution started washing etc stronger & stronger until finally it very strong, It then can be Evaporated down by a 2 or 3 stage Yaran Vacuum Evaporator till ready to Extract the Lithium -

With Ambiguous, Wooden Tanks are necessary & 2 pumps on

& carry on to full extraction
Magnesium Oxide &
get reaction,

Remarks before
leaving for Flia —

Try Clay & Al_2SO_4 -
heated but not so it
dont go to a soup
etc & test —
also H_2SO_4 alone &
afterwards Lime
also Alum (Na) &
also Sulfate Aluminum
also Bisulfate soda

Then on Lepidolite & also
Spod — but think
Lime for Spod is OK
& Perhaps Lepidolite

(55)

Continued

1 Ton or 7/10 Ton of alum (soda) — or 7/10 of Sulphate of aluminum or 1 Ton of 60 Baume acid Can be used,

As Ambling needs an acid salt — Thus good many times quicker than Spod of Lep with the alkali as Lime dissolves very slightly & requires time while Alum or Aluminum Sulfate or H_2SO_4 dissolves Easily —

I am not sure but think the Lime Extraction has alkali in form of Hydroxides —

Ambling I think is a sulphate. —

for battery the K or Na need not be separated out

all made hydroxide &
allowed for,

If there is humble with
final solution may
have to evap down for
crystals Li ~~[illegible]~~
As Carbonate & then
Causticize with Lime
as usual —

If the residue is full of
Alum or Na_2SO_4 probably
Carbonate method or
alcohol ~~[illegible]~~ or
Cryolite take most
out Orange ~~[illegible]~~ & take
but please for factor
& buy ore & also purchase
area or more of East
mine for reserve if $20,000
trade is necessary

but dont attempt to mine best
lease & buy on a % of Li
3% Spod $5 - 3½ $6 4% 7
Lepidolite 6 7 8
Amblig - $15. for 8% & less
as % goes down Li_2O is
basic —

Amblygonite Sols may have
to be limed (10) Caustic lime
will take out alumina
& fluorine & phosphorus

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231

END

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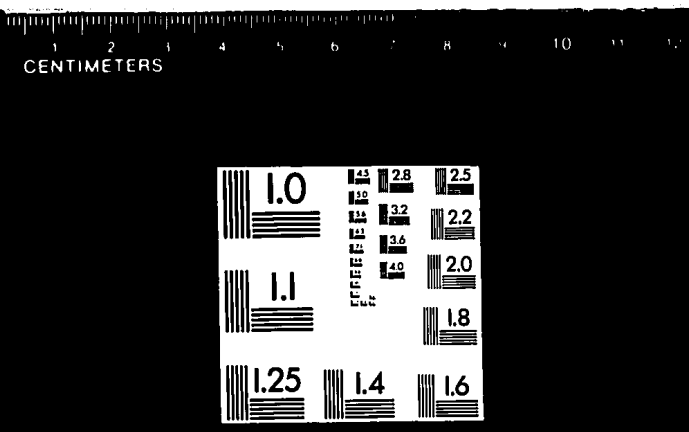

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